

STRUCTURE OF THE MICROCARD (BASIC INSTRUCTION)

A02 = How to use the microcard	1	2	3	4
A01 = Structure of microcard			SIS	
B01 = Trouble-shooting chart	-A-***X*	X*XXX	XXXXX	XXXXX *XXXX X
	-B-*XXXX	XXXXX	XXXXX	XXXXX XXX
	C-XXXXX	XXXXX	XXXXX	XXXXX XXX
	D-XXXXX	XXXXX	XXXXX	XXXXX XXX
	E-XXXXX	XXXXX	XXXXX	XXXXX XX
	F-XXXXX	XXXXX	XXXXX	XXX
	G-XXXXX	XXXXX	XXXX	
	H-			
	J-			
	K-			
	L-			
	M-			
N01 = Service Information	-N-*XXXX	XXXXX	XXXXX	XXX *X XX*
	12345	67890	12345	67890 12345 678
		1	2	
			Index	

N28 = Table of contents and publication information

- 1 = Special features
- 2 = Safety and precautionary measures
- 3 = Test equipment and tools
- 4 = Installation position of components

- a. Read from left to right.
- b. Title of micropicture (appears on each coordinate).

E16	Product/component/test step	
	Coordinate	

c. Limits of section

Beginning	Mid-section	End	One-page section
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A01		=> <=
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HOW TO USE THE MICROCARD

Trouble-shooting instructions for  
System: VE..F..  
Descriptions, photos, terminal designations and special features refer to the following vehicle:

OPEL Corsa D  
with 1.5 l / 4-cylinder engine 09.87 ->

These basic instructions are detailed trouble-shooting instructions. They must not be used as vehicle-specific instructions.  
Note! Descriptions and photos may deviate from those in the vehicle-specific brief instructions.

Binding set values, terminal assignments and special features must be taken only from the vehicle-specific brief instructions.  
For brief instructions, see the table-of-contents microcard KFZ-00..

A02		=> <=
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# SAFETY AND PRECAUTIONARY MEASURES (continued)

Never start engine without battery being firmly connected (battery terminals bolted tight).  
Do not disconnect battery from the vehicle electrical system with the engine running.

Do not use a fast charger for starting the engine.

Render starting assistance only with a second 12 V battery and jumper cables.

Caution! Due to non-uniform requirements placed by vehicle manufacturers on electronic products, we do not recommend the use of 24 V batteries for starting assistance.

When charging the battery in the vehicle or rendering starting assistance, observe the directions given in the operating instructions of the fast charger as well as those provided by the vehicle manufacturer.

Prior to charging or fast-charging the battery, disconnect it from the vehicle electrical system.

Incorrect polarity of the supply voltage, e.g. due to incorrect connection of the battery or ignition coil, can lead to irreparable damage to a control unit.

Do not connect or disconnect the wiring harness from control units or trigger-box with the ignition switched on.

Prior to exposure to temperatures above +80°C (paint-dry installation) remove control units.

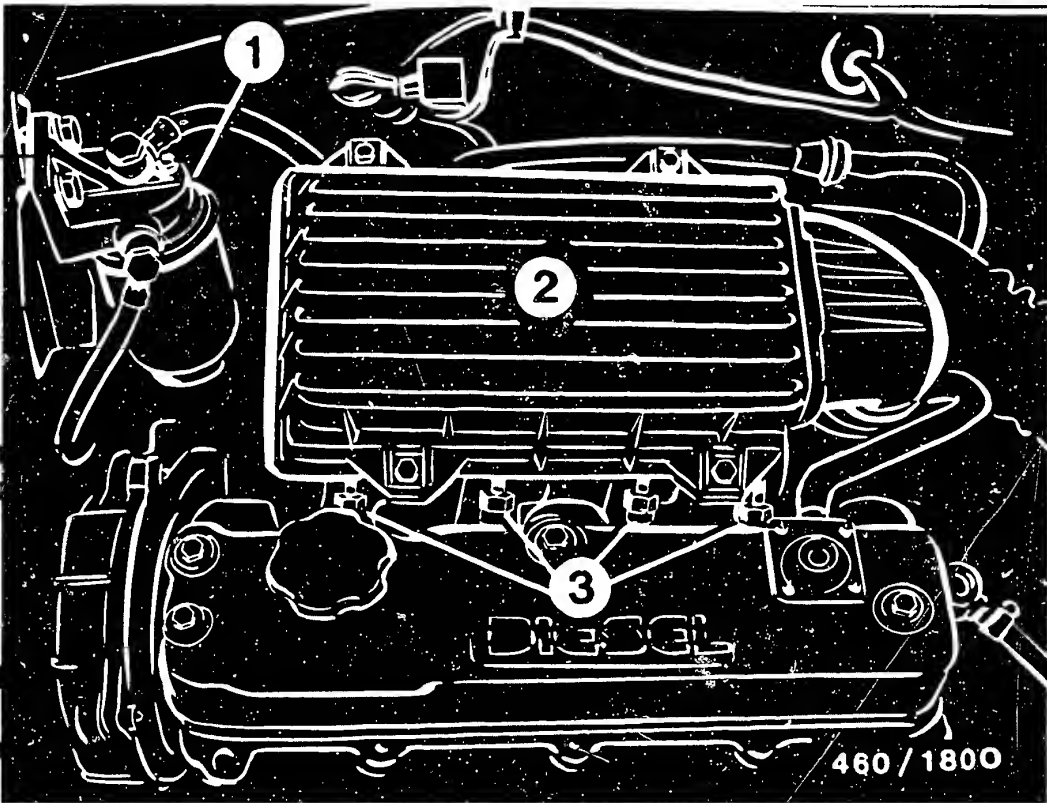
Control units must be removed before electric spot welding.

# TEST EQUIPMENT AND TOOLS

Designation	Part No.	Application
Mini dial indicator 1/100 mm divisions	Commercially available e.g. Hahn & Kolb D-7000 Stuttgart 30 Part No. 33003 with adapter KDEP 1127	Coordination, pump - engine (injection timing)
Nozzle tester	EFEP 60H 0 681 200 502	Testing injection nozzles
Compression tester	Commercially available	Testing engine compression
Compression-loss tester	EFAW 210 A 0 681 001 901	Testing engine compression loss
Tachometer	Commercially available	Adjusting engine speed
Differential- pressure gauge	Commercially available e.g. Henni Co. NG160/311-911/ -1.0 + 4.0bar Henni Co. Nauheimer Str. 78...80 D-7000 Stuttgart 50	Filter test
Smoke tester	0 684 102 050	Smoke test
Accessories box with sampling pump	0 681 169 038 or 0 681 169 058	
Puller	KDEP 1118	Removing injec- tionpump gear

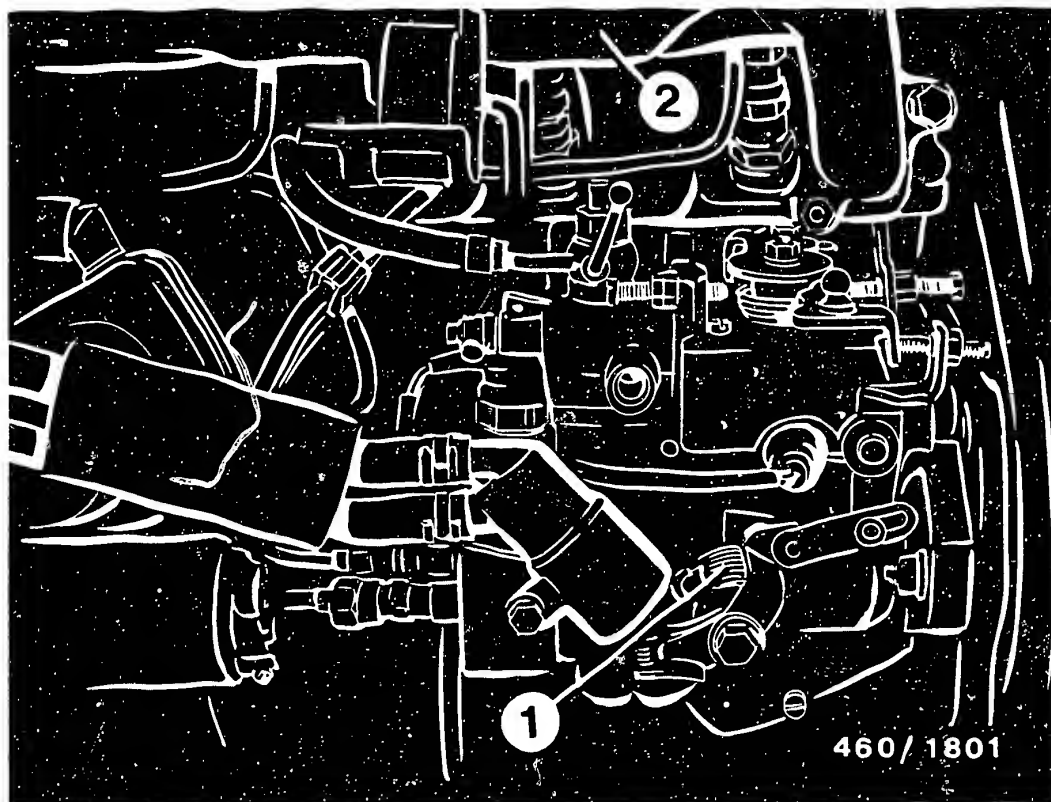
TEST EQUIPMENT AND TOOLS (CONTINUED)

Designation	Part No.	Application
Socket wrench	Commercially available e.g. Hazet Co. D-5630 Remscheid 1 Part no.900TZ-22	Removing nozzle- holder assembly
Ring wrench	KDEP 1115	Loosening/tighten fuel-injection pu
Measuring tool	KDEP 1085	Coordination, pump - engine (injection timing)
Multimeter	e.g. BOSCH MMD 301 Part no. 0 684 500 301	Testing preheatin system



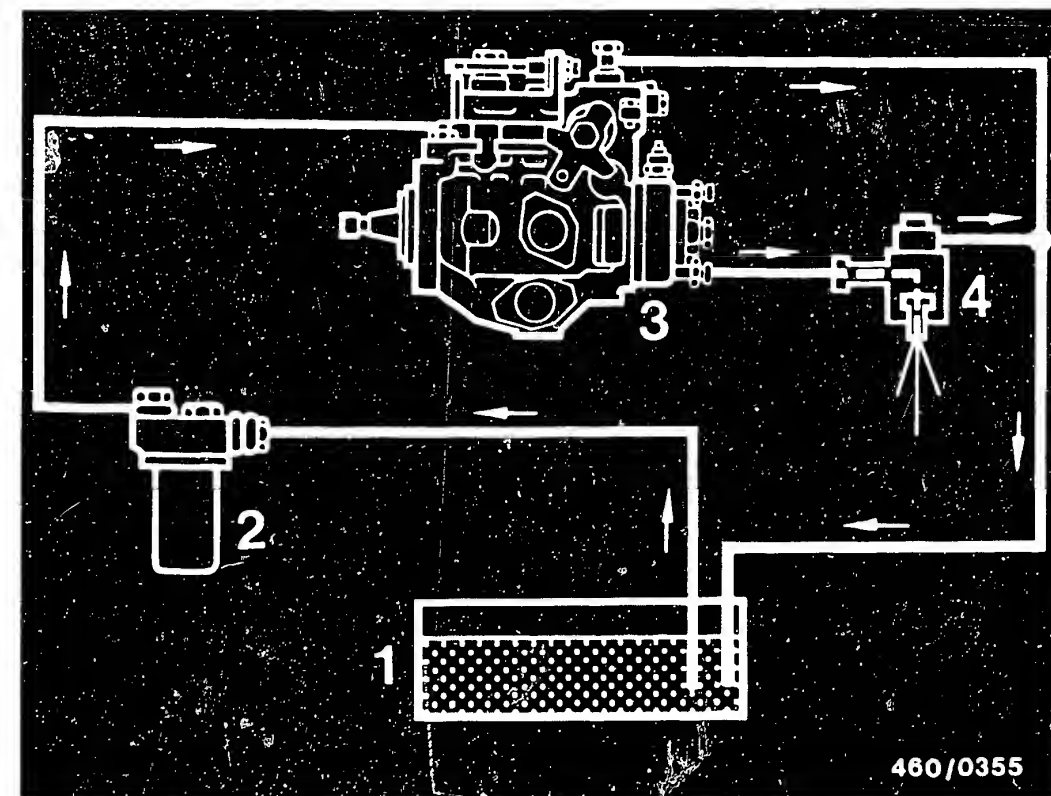
- 1 = Fuel filter
- 2 = Air-filter housing
- 3 = Injection nozzles

INSTALLATION POSITION OF COMPONENTS



- 1 = Temperature controlled  
cold start injection advance (KSB)
- 2 = Intake manifold

#### INSTALLATION POSITION OF COMPONENTS

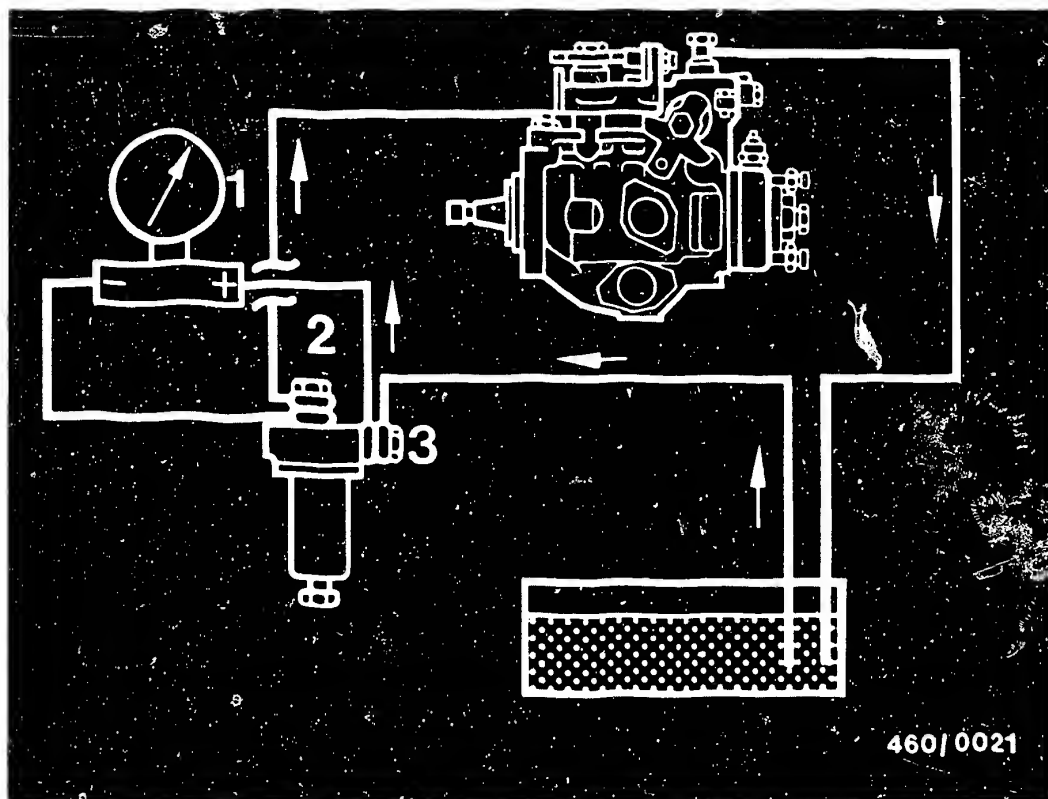


- 1 = Fuel tank
- 2 = Fuel filter
- 3 = Distributor-type fuel-injection pump
- 4 = Injection nozzles

#### DIAGRAM OF FUEL LINES

The fuel lines are connected as shown in the above diagram.

The fuel flows in the direction of the arrows.



- 1 = Differential-pressure gauge
- 2 = Filter outlet (use inlet union and extra-long inlet-union screw 2 443 456 020).
- 3 = Filter inlet (use inlet union and extra-long inlet-union screw 2 443 456 020).

#### CONNECTION DIAGRAM FOR FILTER TEST

Connect differential-pressure gauge to fuel filter using appropriate connecting pieces.

For production reasons:  
continued on the following  
coordinate.

HOW TO USE TROUBLE-SHOOTING CHART AND  
TROUBLE-SHOOTING PROGRAM

The TROUBLE-SHOOTING CHART starts on coordinate B02 and contains customer complaints (fault symptoms) with several possible causes (component faults) in each case as well as coordinate references for detailed trouble-shooting. If no coordinate reference is given, this is a cause for which no test instructions are required.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty (when warm or cold)
2. Engine hunts when idling
3. Rough idling when engine is warm
4. Fuel consumption high, maximum engine power not reached, and smoke formation
5. Unsatisfactory performance
6. Black smoke in full-load range, engine running rough; possibly lack of power
7. Engine running rough

Cause (Component fault)										Coord.
*	*				*					Tank empty, tank vent B06
*		*								Injection sequence not firing order B07
	*				*					Inlet-union screws, inlet/return B08
*										Shutoff device B09
		*			*					Air in fuel system B12
	*									Paraffin separation B15
										Fuel lines leaking B21
*					*					Fuel lines clogged B21
*					*					Supply lines clogged B21
					*					Engine air filter B22
		*								Idle speed C05
*		*			*		*			Injection nozzle C09
*										Preheating system C19

## TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

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Cause (component fault)										Coord.
*					*					Fuel filter C16
					*	*	*			Timing device D01
*	*									Engine compression D02
				*	*	*	*			Coordination, pump - engine (injection timing) F09
				*	*	*				Engine timing E17

## TROUBLE-SHOOTING CHART (Continued)

Customer complaint (symptoms of trouble)

8. Engine misfiring during vehicle operation
9. Engine cannot be switched off
10. Incorrect engine speeds
11. Engine will not rev up when cold
12. High idle and engine running rough at high engine speed
13. Black smoke in full-load range
14. Fog-like smoke in full-load range (white)

Cause (component fault)										Coord.
*										Tank empty, tank vent B06
*										Injection sequence not firing order B07
*										Inlet-union screws, inlet/return B08
*	*									Shutoff device B09
*										Air in the fuel system B12
*										Paraffin separation B15
*										Fuel lines leaking B21
*										Fuel lines clogged B21
*										Supply lines clogged B21
				*						Engine air filter B22
	*									Idle speed C05
*										Injection nozzle C09

## TROUBLE-SHOOTING CHART (Continued)

Customer complaint (symptoms of trouble)

8. Engine misfiring during vehicle operation

9. Engine cannot be switched off

10. Incorrect engine speeds

11. Engine will not rev up when cold

12. High idle and engine running rough  
at high engine speed

13. Black smoke in full-load range

14. Fog-like smoke in full-load range  
(white)

						(white) Cause (component fault)	Coord.
*						Fuel filter	C16
				*		Timing device	D01
		*				Engine compression	D02
		*		*		Coordination, pump - engine (injection timing)	F09
*						Engine timing	E17

## CHECK TANK VENT

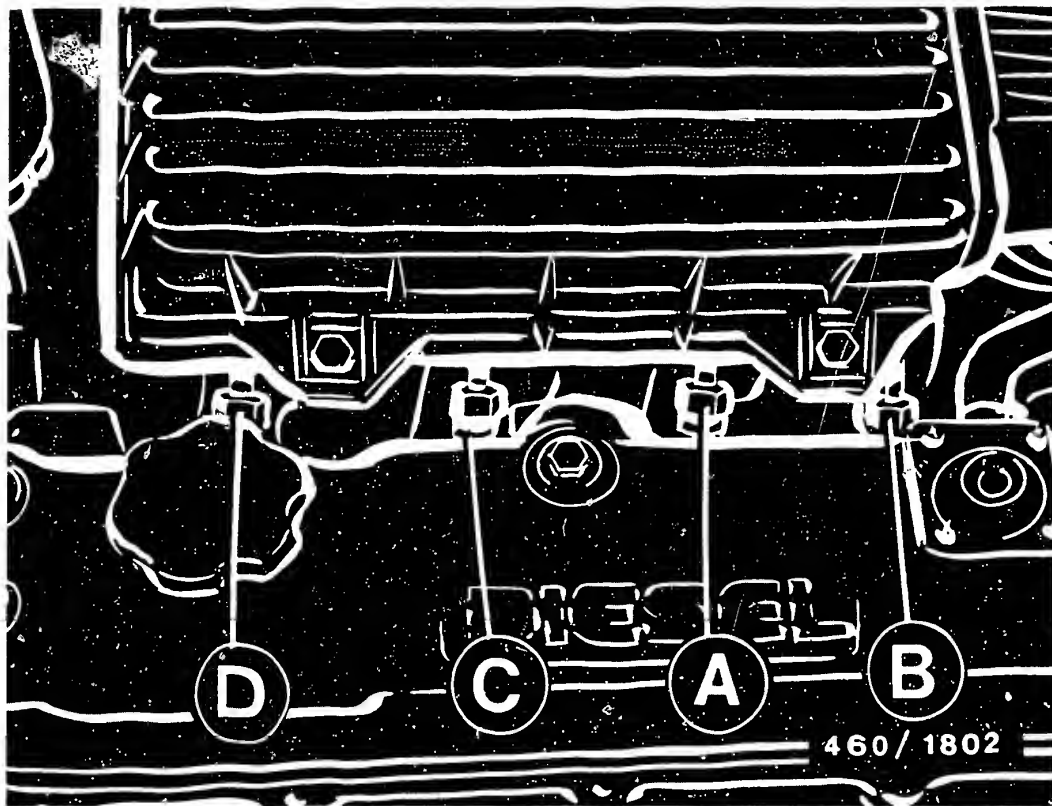
Open tank filler cap.

If the fault disappears after opening the filler  
cap, the tank vent is defective.Remove tank-vent hose lines and check for clogging  
or constriction.

If necessary, check fitting on tank.

Return to trouble-shooting chart B02





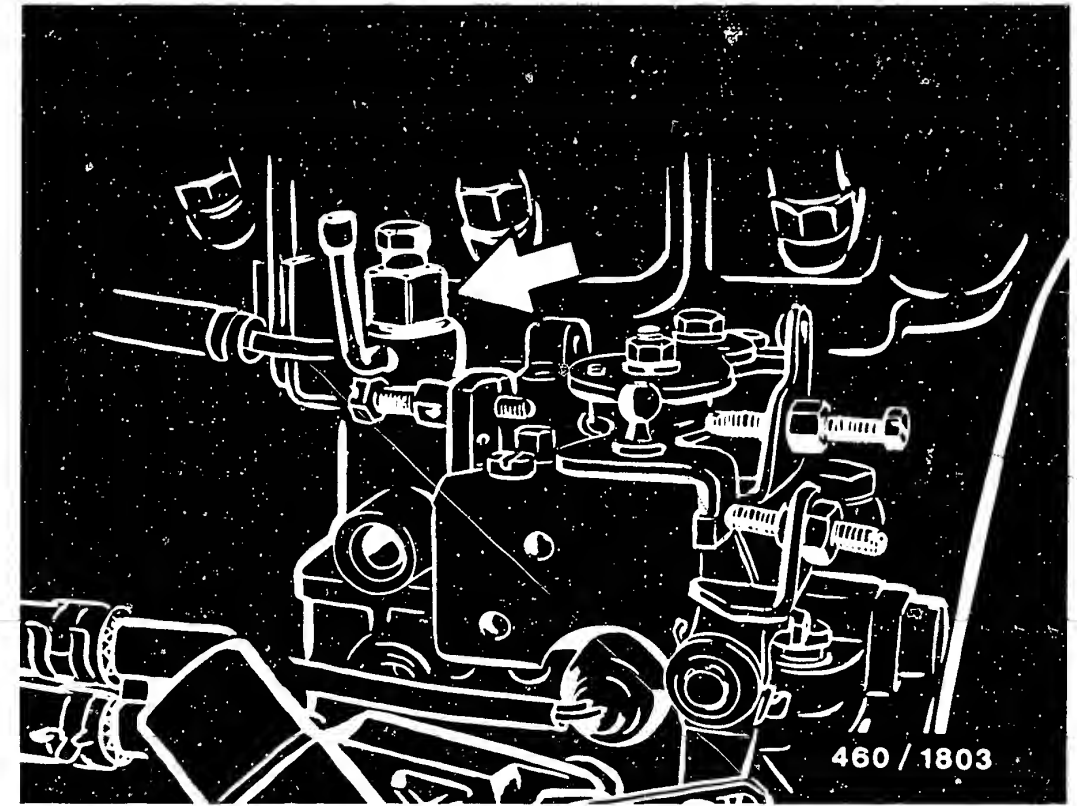
#### CHECK ROUTING OF FUEL-INJECTION TUBING

The individual fuel-injection lines are held together by clamps so that it is impossible for the outlets to be mixed up.

If, however, there is any doubt, check the routing of the lines as shown in the illustration above.

The pairing of the fuel-injection pump outlets with the individual engine cylinders is identified by the letters A to D.

Return to trouble-shooting chart B02



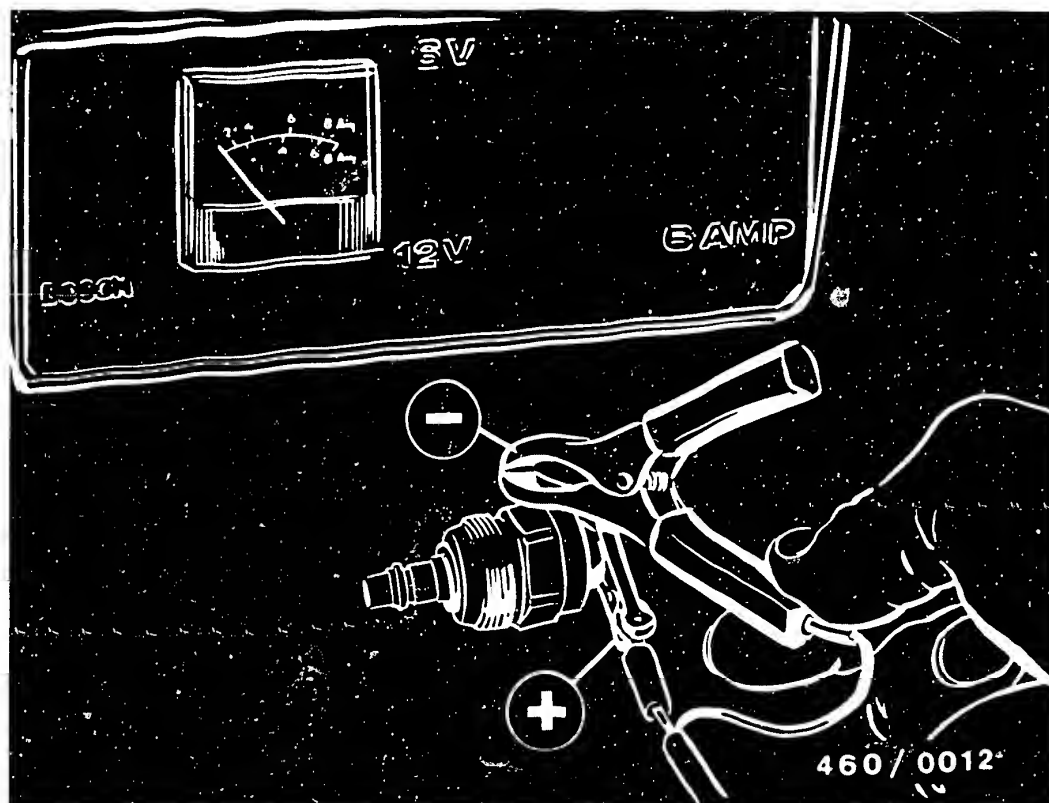
#### CHECK OVERFLOW RESTRICTION

Unscrew overflow restriction from injection pump (arrow).

Check wire strainer fitted for dirt (visual examination).

If in doubt, replace overflow restriction.

Return to trouble-shooting chart B02



# TESTING EMERGENCY SHUTOFF DEVICE FOR CORRECT OPERATION

Engine does not start.

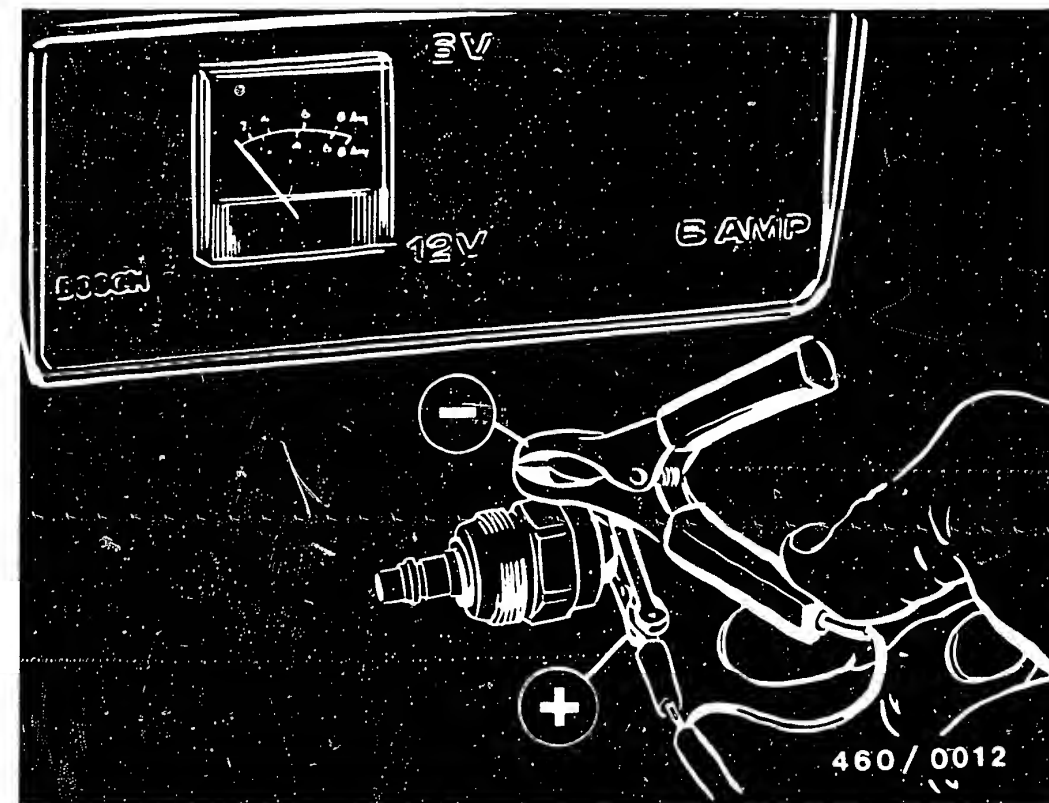
Test whether solenoid-operated valve is supplied with voltage (at least 10 V) when ignition is switched on.

If voltage is available, remove solenoid-operated valve.

Make sure that everything is kept c l e a n !

Test the solenoid-operated valve for correct operation while it is removed.

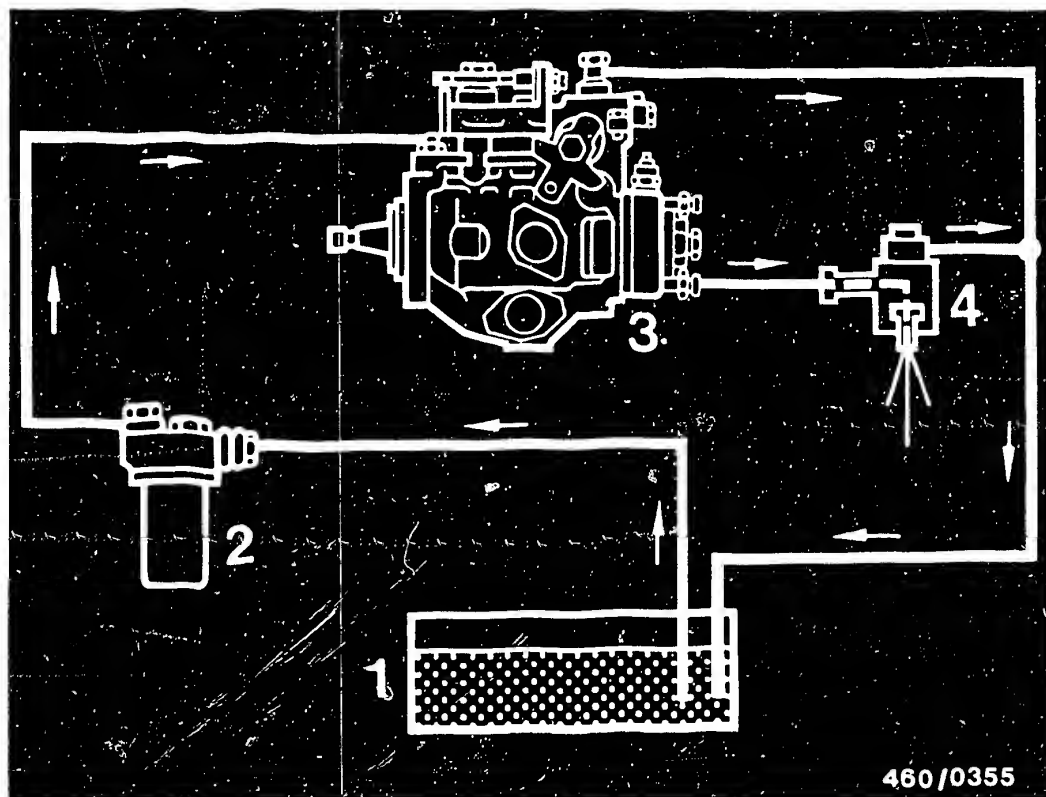
Note:  
Solenoid-operated valve must be supplied with voltage only for a short time while removed, since there is no fuel to cool it.



# SOLENOID-OPERATED VALVE TEST

Remove fuel-injection tubing.  
Take out solenoid-operated valve.  
**CLEANLINESS IS ESSENTIAL!**  
When removed, check operation of solenoid-operated valve.

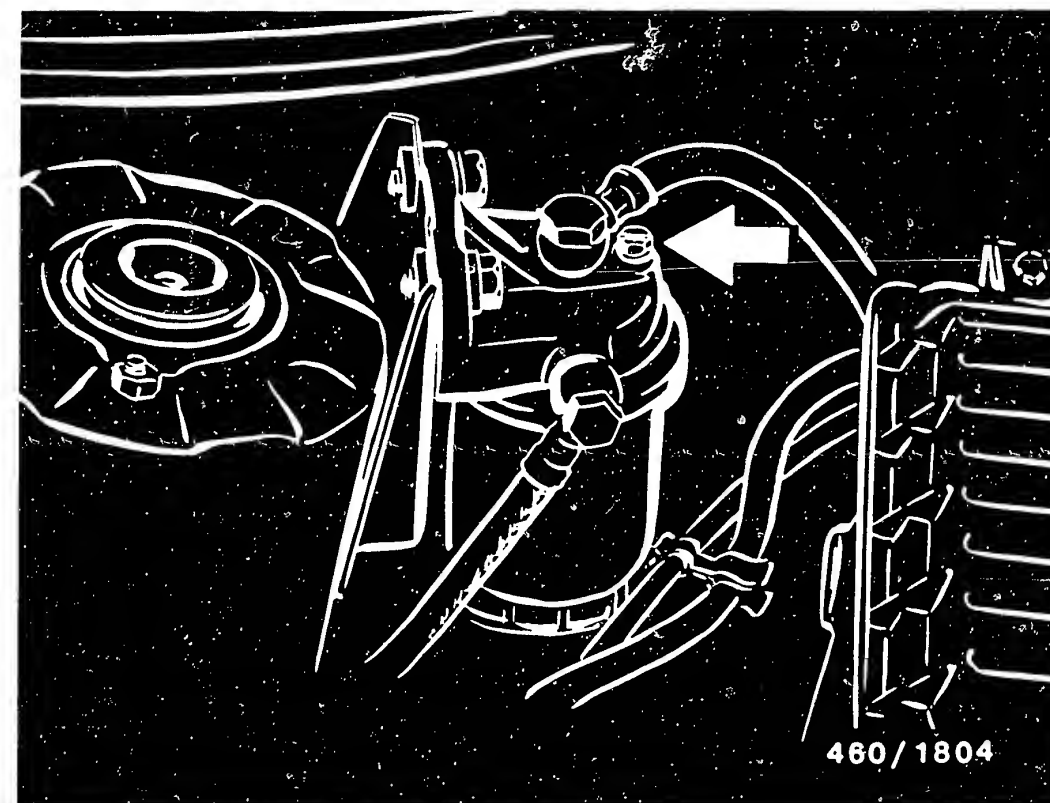
Note:  
When removed, the solenoid-operated valve must be supplied with voltage only for a short period of time since it is no longer being cooled by the fuel.  
Check valve seat in hydraulic head (visual examination).



- 1 = Fuel tank
- 2 = Fuel filter
- 3 = Distributor-type fuel-injection pump
- 4 = Injection nozzles

#### CONNECTION DIAGRAM OF FUEL LINES

The fuel lines are connected as shown in the above diagram.  
The fuel flows in the direction of the arrows.

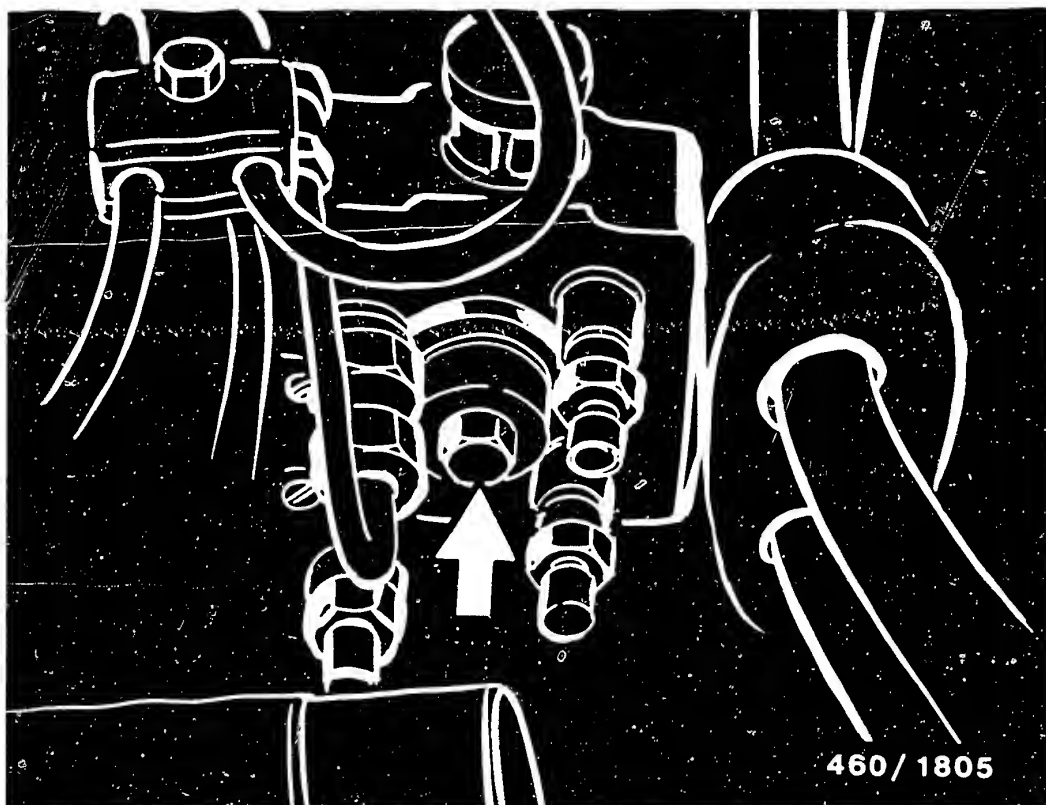


Arrow = Bleeder screw

#### BLEED FUEL SYSTEM

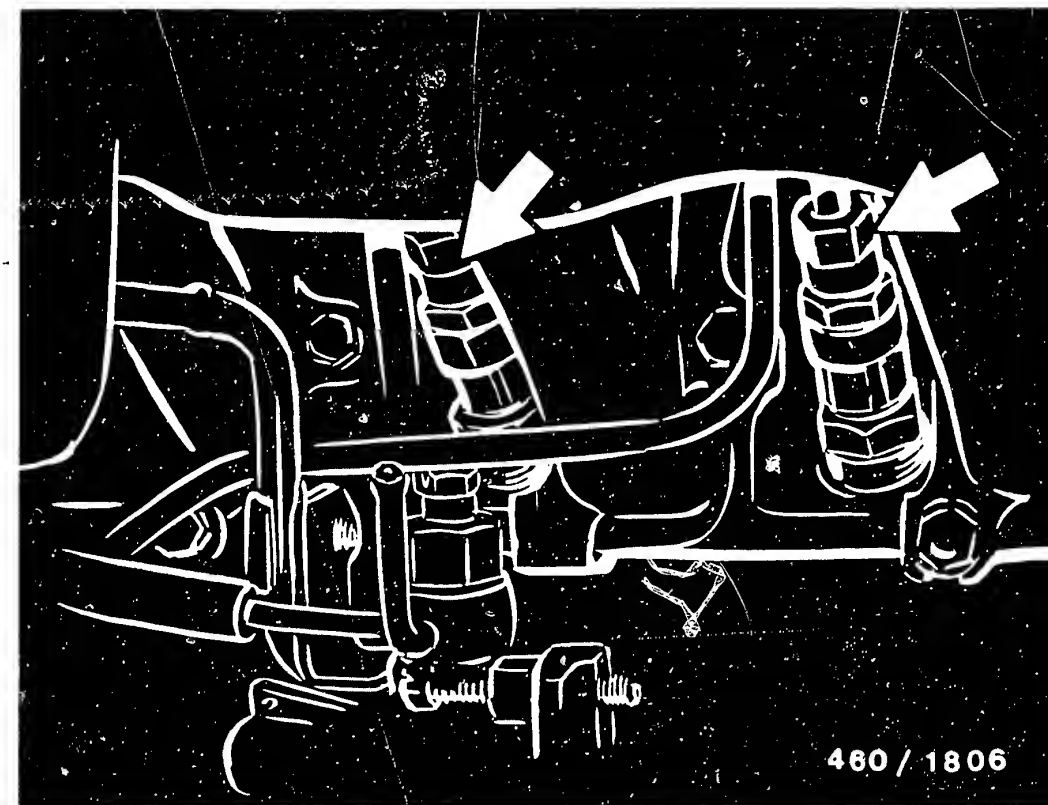
Fill up the fuel filter and injection pump with diesel fuel.

Seal off bleeder screw on fuel filter.



Arrow = Bleeder screw, pump

Operate starting motor without preheating until fuel escapes.  
Tighten bleeder screw.



Loosen union nuts of fuel-injection tubing on nozzle-holder assemblies (arrows).

Operate starting motor without preheating until fuel escapes from union nuts of nozzle-holder assemblies.

Tighten union nuts.

Operate starting motor until engine starts.

Return to trouble-shooting chart B02



# REPLACE AND DRAIN WATER FROM FILTER BOX

Replace filter box

Unscrew fuel filter (arrow) from filter cover.

If stuck, loosen filter box using special wrench,  
e. g. Matra W 167.

Catch any fuel which escapes.

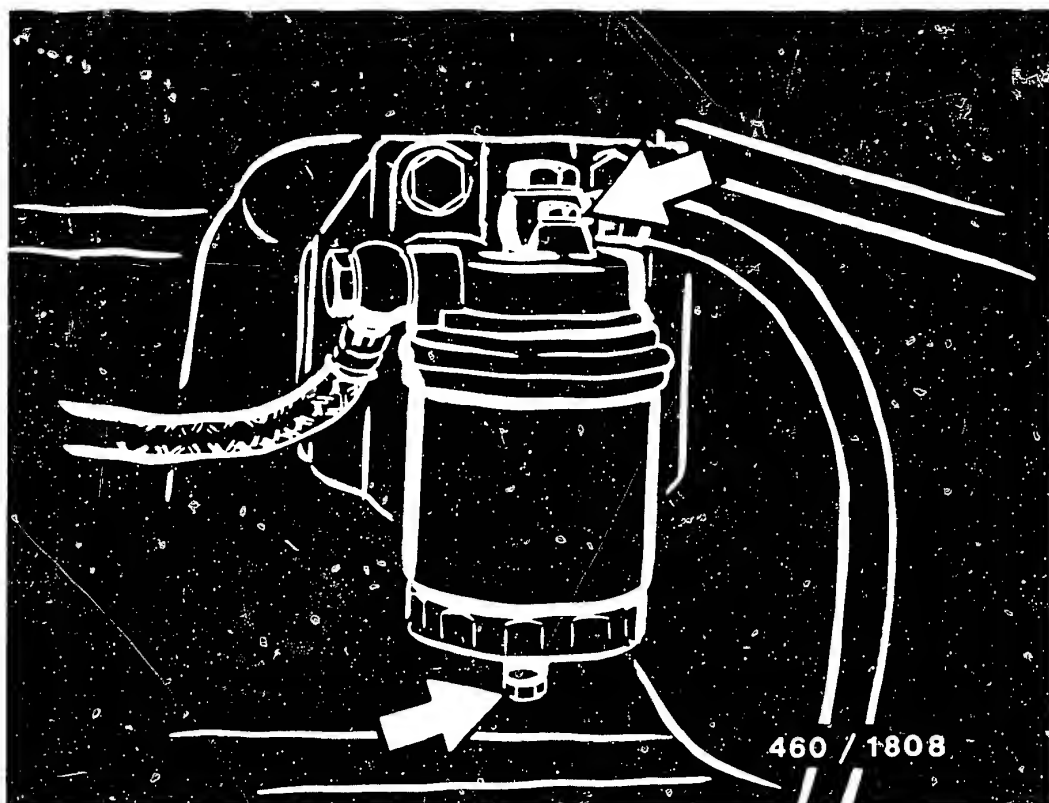


Rub diesel fuel into the rubber seal (arrow)  
of the fuel filter box.

Screw the filter box into the cover by hand  
and tighten.

Check the fuel filter for leaks.

In the case of winter fuel, it may be necessary  
to add petroleum as specified by the vehicle  
manufacturer.



Drain water from fuel filter.

Loosen bleeder screw (upper arrow) on filter cover a few rotations.

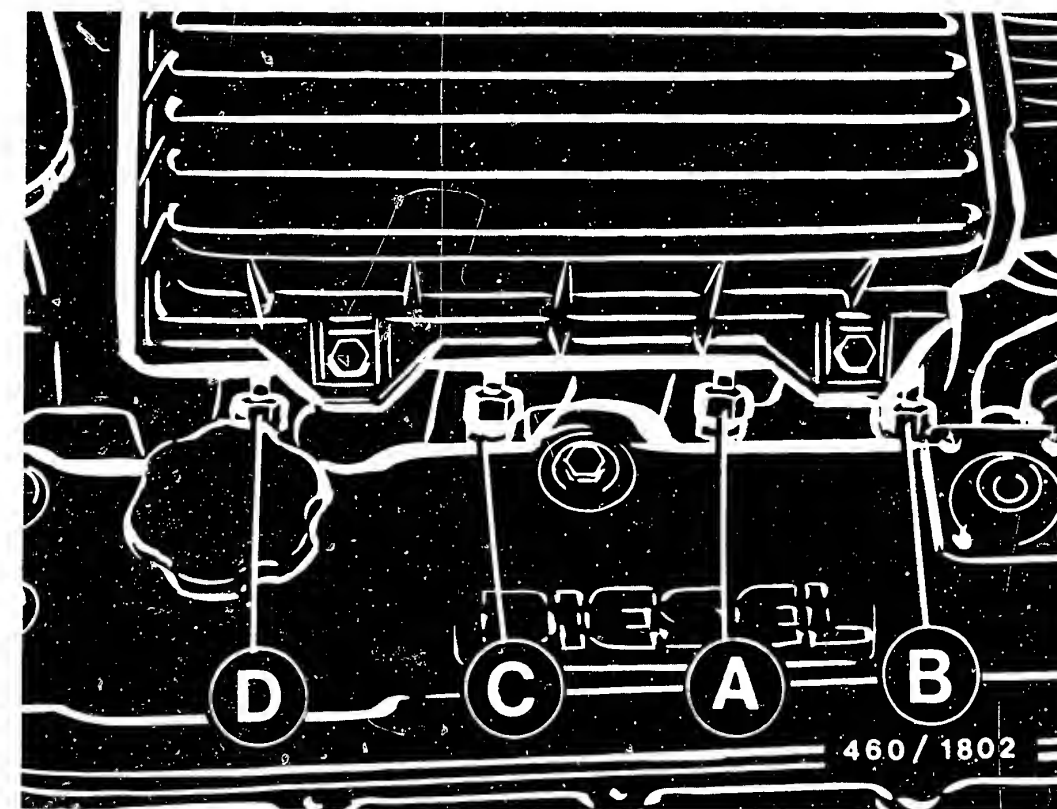
Loosen water-drain plug at bottom of filter (lower arrow) and drain water.

Catch fluid in collection vessel.

Tighten water-drain plug and bleeder screw and check for leaks.

If necessary, bleed air from fuel filter.

Return to trouble-shooting chart B02



CHECK INJECTION SYSTEM FOR LEAKS

The leak test must be performed with the engine at normal operating temperature.

Examine all connection points of the fuel lines.

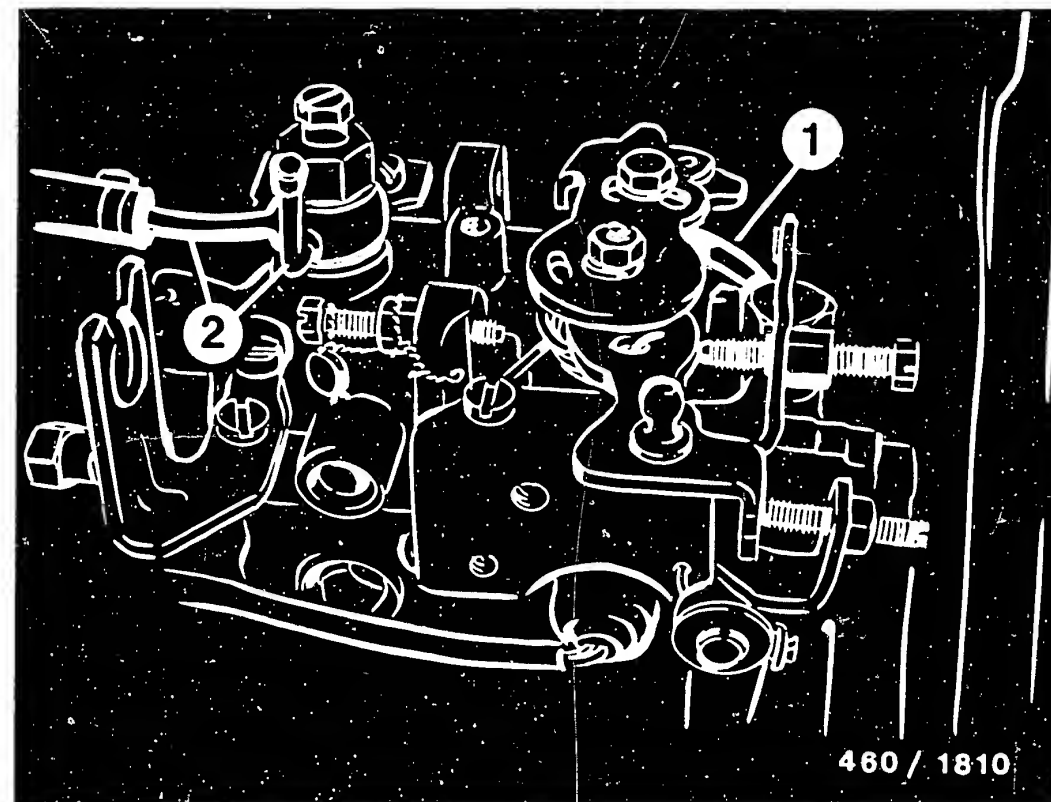
Pay particular attention to:

\* Connections on the nozzle-holder assemblies (A...D).





\* Connections on fuel filter (arrows).

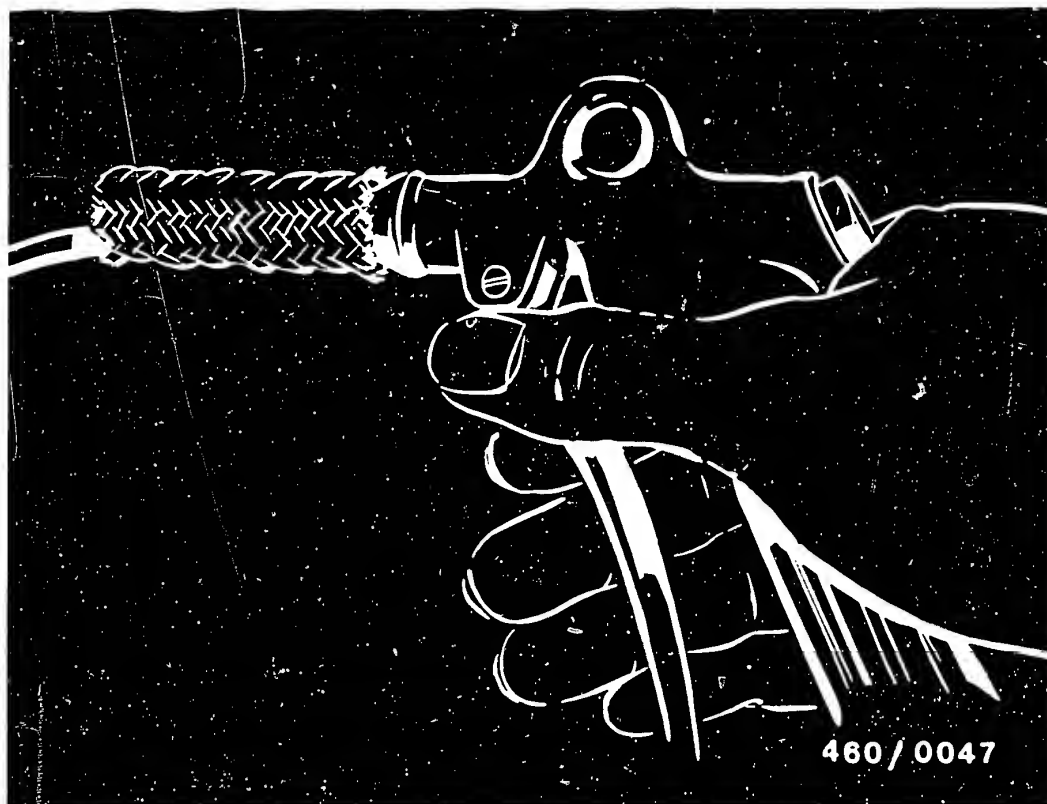


1 = Inlet line  
2 = Return lines

\* Inlet line and return lines on distributor-type fuel-injection pump.

\* Delivery-valve holders on hydraulic head.

Check fuel lines for hairline cracks



460/0047

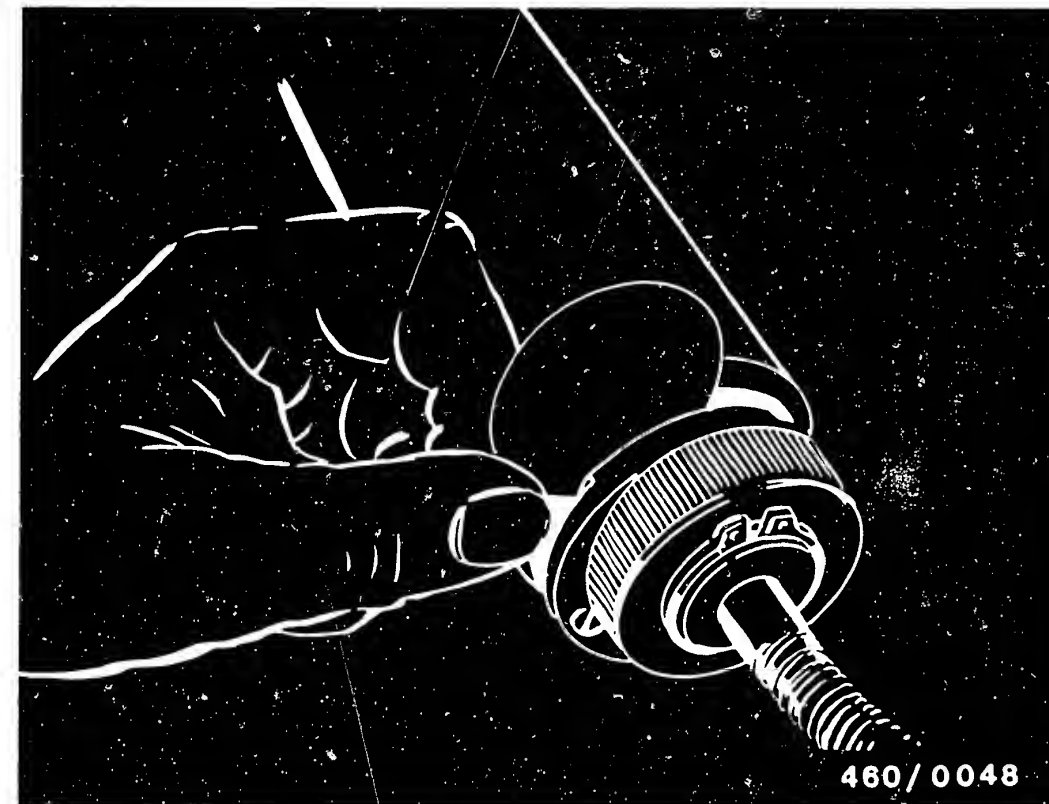
### FUEL-LINE INSPECTION

Carry out visual test of suspect fuel lines.

If no pinching or kinking is found, the fuel line in question must be removed.

Use compressed air to check fuel line for flow-through; if necessary, clean line.

A suitable hose section can be used as a side seal for blowing out the fuel lines.



460/0048

### SMOKE TEST - CHECKING AIR FILTER

#### Test setup

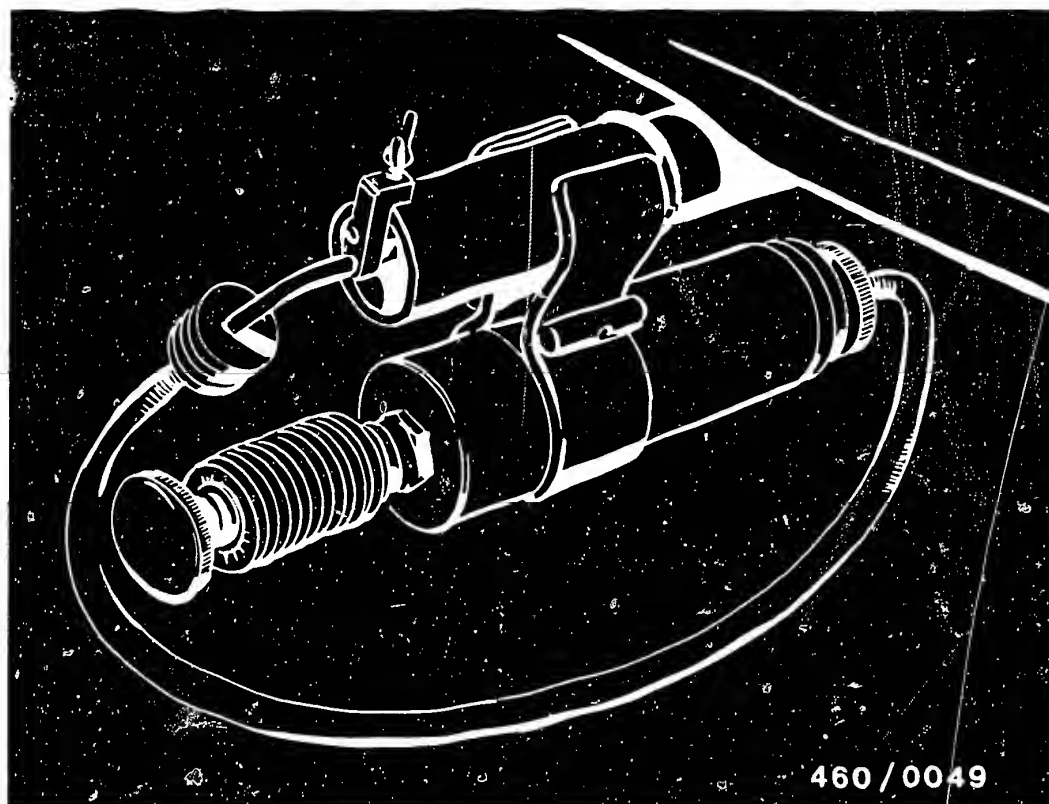
The smoke test is conducted using the Bosch filter-type smokemeter.

The filter-type smokemeter consists of the following units:

- \* Accessories box with proportioning pump 0 681 169 038  
or 0 681 169 058
- \* Evaluating unit 0 684 102 050

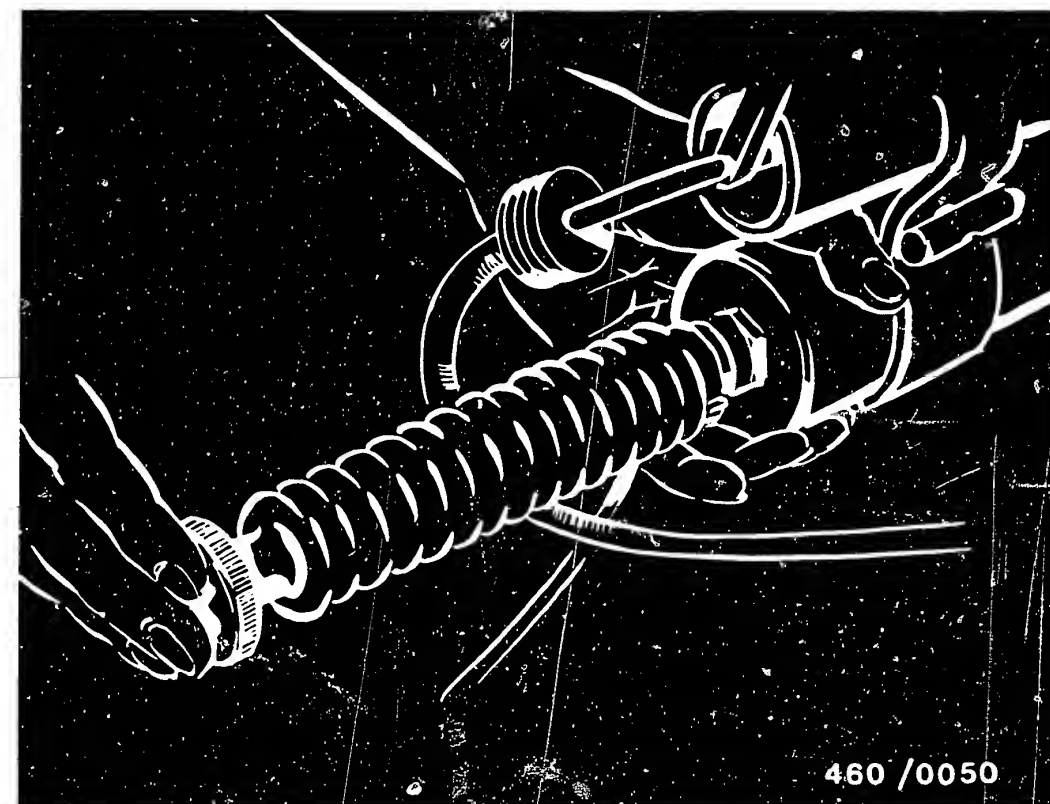
Insert filter plate into proportioning pump (for filter-type smokemeter 0 681 169 038).





Mounting respective sampling pump on exhaust pipe using appropriate clamp.

Introduce exhaust-sample pickup as far as possible into exhaust pipe and clamp in position.



Measurement in accordance with the equilibrium method

Set the proportioning pump by pressing in the black push-button.

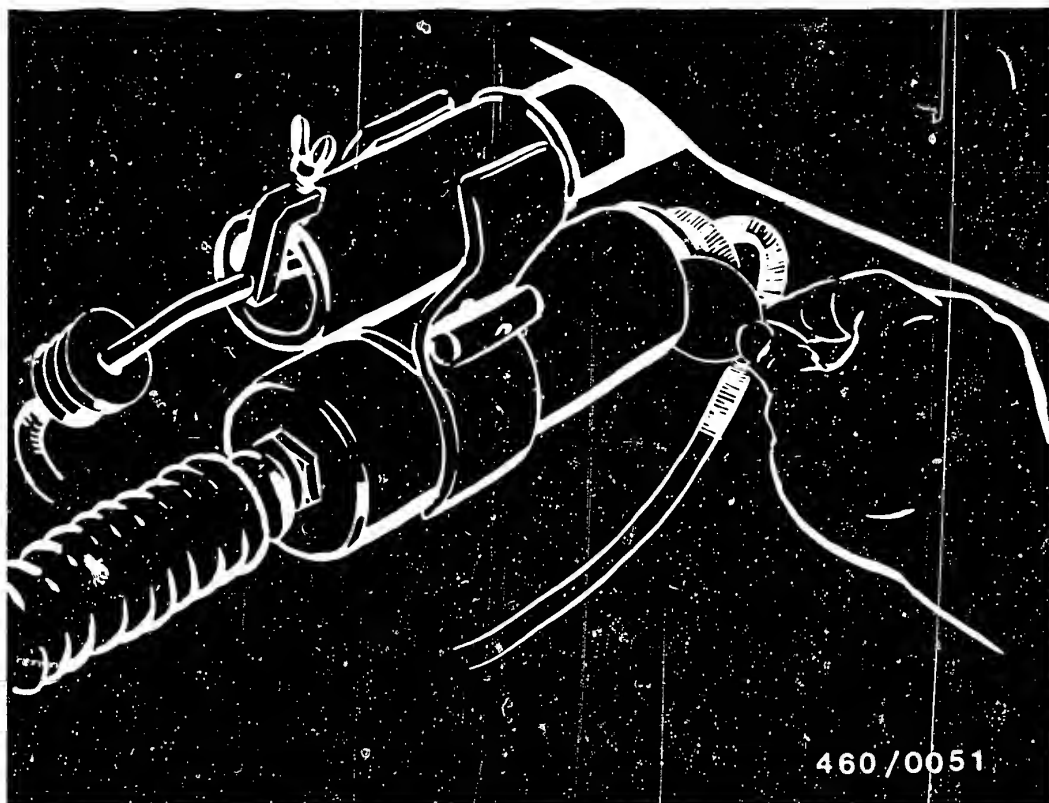
Take rubber ball on triggering hose and enter passenger compartment.

The test can be performed on the chassis dynamometer or on the road (gradient).

The chassis dynamometer is preferable in any case.

Find the gear in which, with the accelerator pedal in the full-load position, a speed of approx. 40 km/h is reached.

Load the engine so that, with the accelerator pedal in the same position, a speed of approx. 25 km/h is reached.



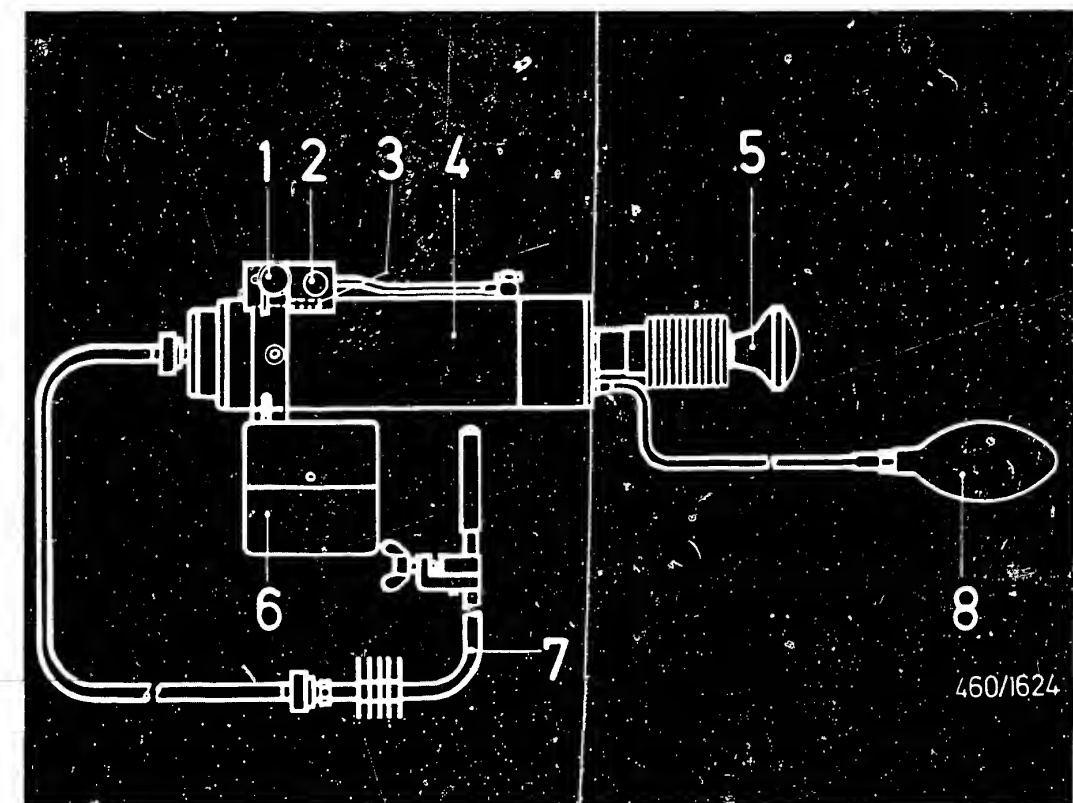
Maintain this load condition for 5 seconds and then trigger the proportioning pump by pressing the rubber ball.

Switch off the engine.

### CAUTION!

During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

Remove the filter plate from the sampling pump.



- 1 = Rotary knob for paper transport
- 2 = Push-button for actuation by compressed air
- 3 = Compressed-air connection
- 4 = Proportioning pump
- 5 = Trigger for manual actuation
- 6 = Magazine for filter-paper roll
- 7 = Exhaust-sample pickup
- 8 = Rubber ball

Measurement in accordance with the acceleration method in conjunction with the filter-type smokemeter 0 681 169 058.

Operating the proportioning pump:

The plunger of the proportioning pump can be positioned to the working position either by hand or by means of compressed air.

There is a corresponding connection (3) and a push-button (1) available for actuation by compressed air.

Clamp the proportioning pump.

### Test requirement:

Taking into consideration the handling and manual operation, we recommend that measurements not be carried out in the open air if it is raining or if the air temperature is below 0° C.

When carrying out the test, the engine must be at normal operating temperature (coolant temp. at least 60° C).

### ATTENTION!

During the following operations, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

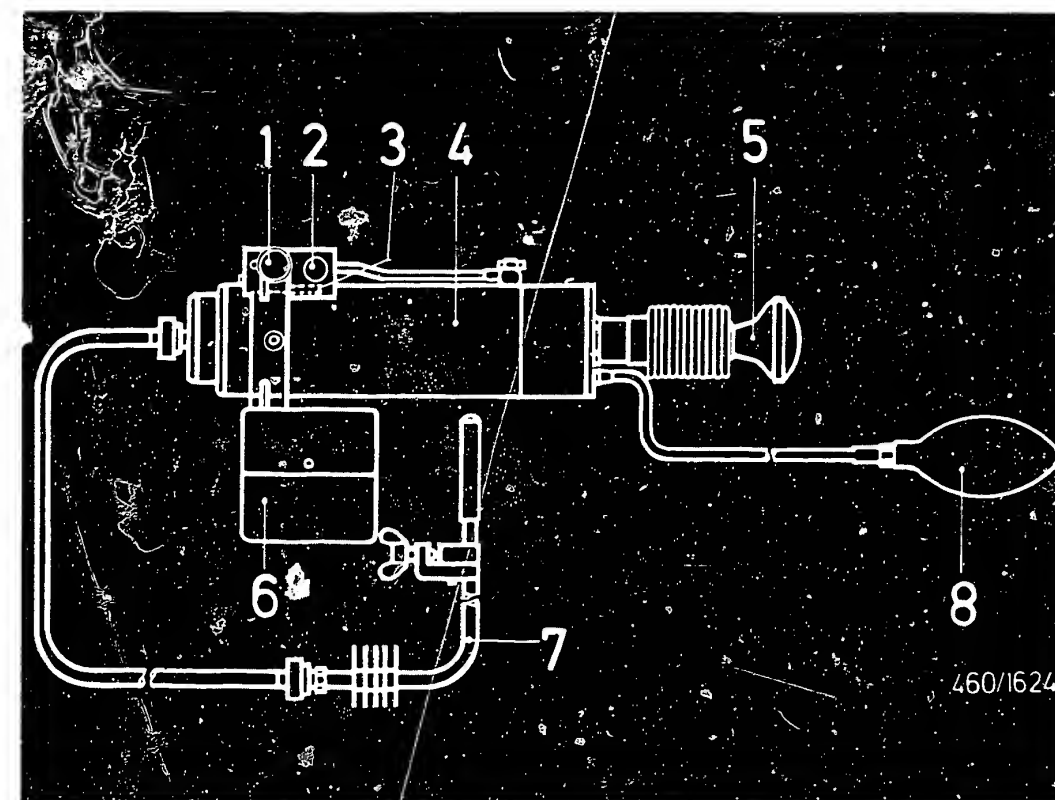
### Test procedure:

To clean the exhaust system, accelerate the engine immediately before measurement to its breakaway speed at least three times in rapid succession.

Approx. 1 second before accelerating for the 4th time, trigger the induction stroke of the proportioning pump by pressing the rubber ball.

Afterwards, stamp the accelerator pedal fully to the floor until the maximum speed of the engine is reached and the fuel-injection pump governor regulates.

When the breakaway speed is reached, release the accelerator pedal immediately (idle position).



- 1.= Rotary knob for paper transport
- 2 = Push-button for actuation by compressed air
- 3 = Compressed-air connection
- 4 = Proportioning pump
- 5 = Trigger for manual operation
- 6 = Magazine for filter-paper roll
- 7 = Exhaust-sample pickup
- 8 = Rubber ball

By actuating the push-button (2), the piston is returned to the working position (when testing with compressed-air supply).

Hold the push-button down until latching has occurred.

Transport the filter paper one knotch further by turning the rotary knob (1) (releasing and applying tension to the filter paper is performed automatically).

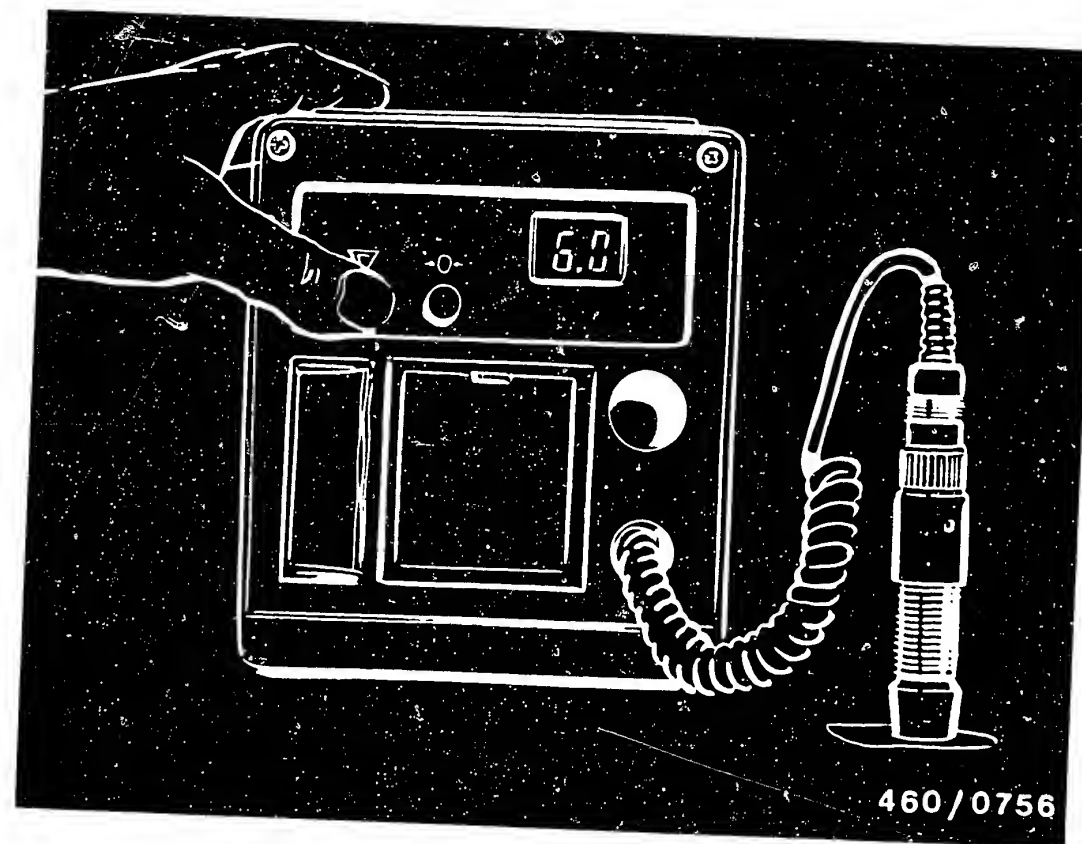
Repeat the measurement three times.

Position the plunger to the working position and tear off the measuring tape covered in soot.

For the acceleration measurement, take as many individual measurements as are required until three successive smoke numbers are obtained which do not deviate from each other by more than 1 Bacharach unit.

Note:

In the case of engines with selectable supercharging, the complete series of measurements must be taken with supercharging selected.



Evaluation of the filter plate

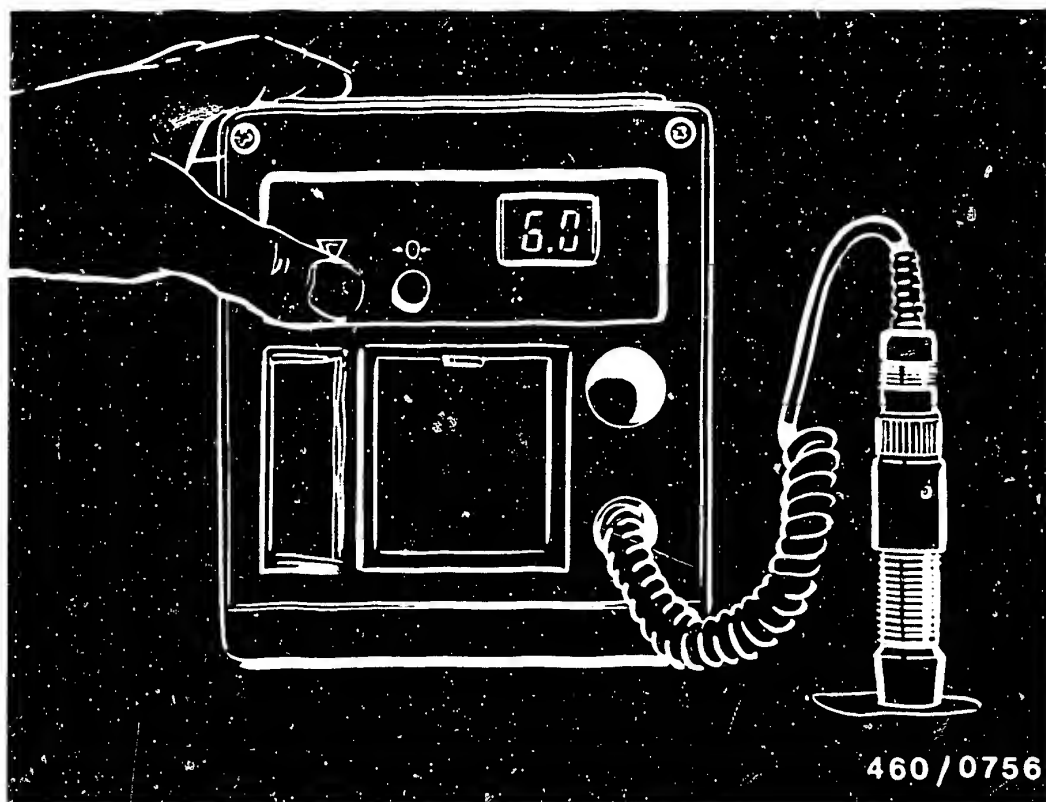
Perform zero point adjustment on the evaluating unit.

The zero point adjustment must be performed

- \* before each series of measurements
- \* if there are changes in the ambient conditions
- \* whenever the lens of the photo-element adapter has been cleaned.

Firmly press the measuring head of the photo-element adapter on to 5 clean white filter plates placed one on top of the other.

Press button "0" until display 0.0 appears. Release button "0".



### Measuring

With the sooted side facing upward, place filter plate from metering unit on 3 new filter plates placed one on top of the other.

Press measuring head vertically on to black surface of the filter plate.  
At the same time, press button "C" until the smoke number measured appears on the display.

### Note:

Measuring head must be firmly mounted both for the zero point adjustment and for measuring (even slight tilting may lead to incorrect measurement).

Determine the smoke number measured with the evaluation sheet. Note kW (bhp) information of vehicle manufacturer.

Check air filter

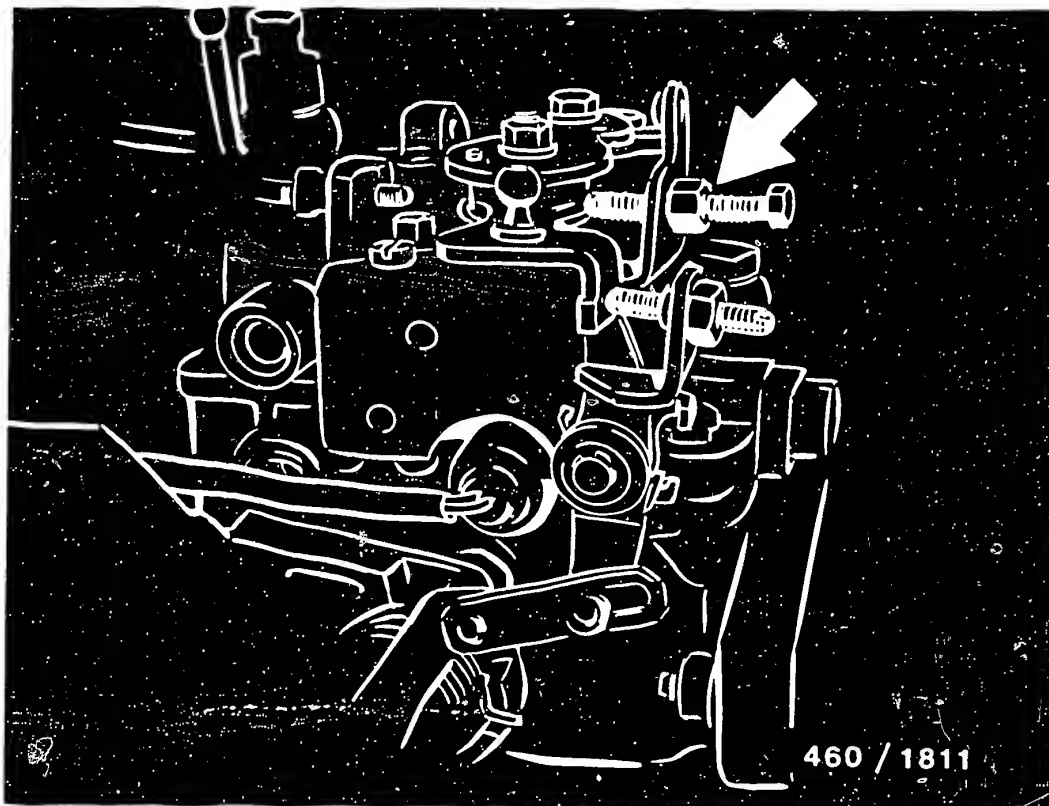
Remove air filter and perform visual examination.

Test criteria for air filter:

- \* dust in air filter  
(check by knocking out air filter)
- \* oil in air filter
- \* foreign bodies in air filter, e. g. leaves

If in doubt, use new filter element.

Return to trouble-shooting chart B02



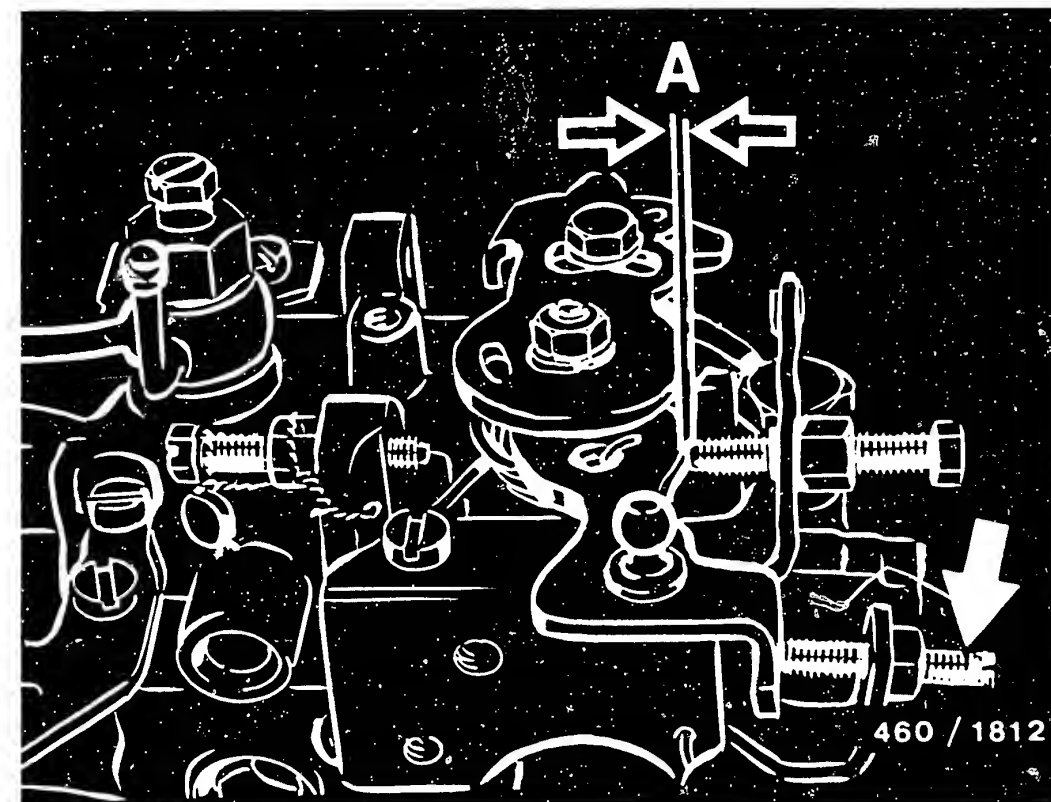
Arrow = Idle-stop screw

#### ADJUST IDLE SPEED

Connect tachometer (e.g. photo-electric) to engine. Start engine and leave to run at idle speed.

For adjusting the idle speed, the engine must be at normal operating temperature.  
Coolant temperature  $+80^{\circ}\text{C}$ .  
Adjust engine speed at idle-adjusting screw to  $780 \dots 840 \text{ min}^{-1}$ .

Note that the camshaft of the engine and injection pump are driven at half the engine speed.  
After adjusting, lock and seal adjusting screw.



Arrow = Intermediate-lever adjusting screw

Adjust idle increase:

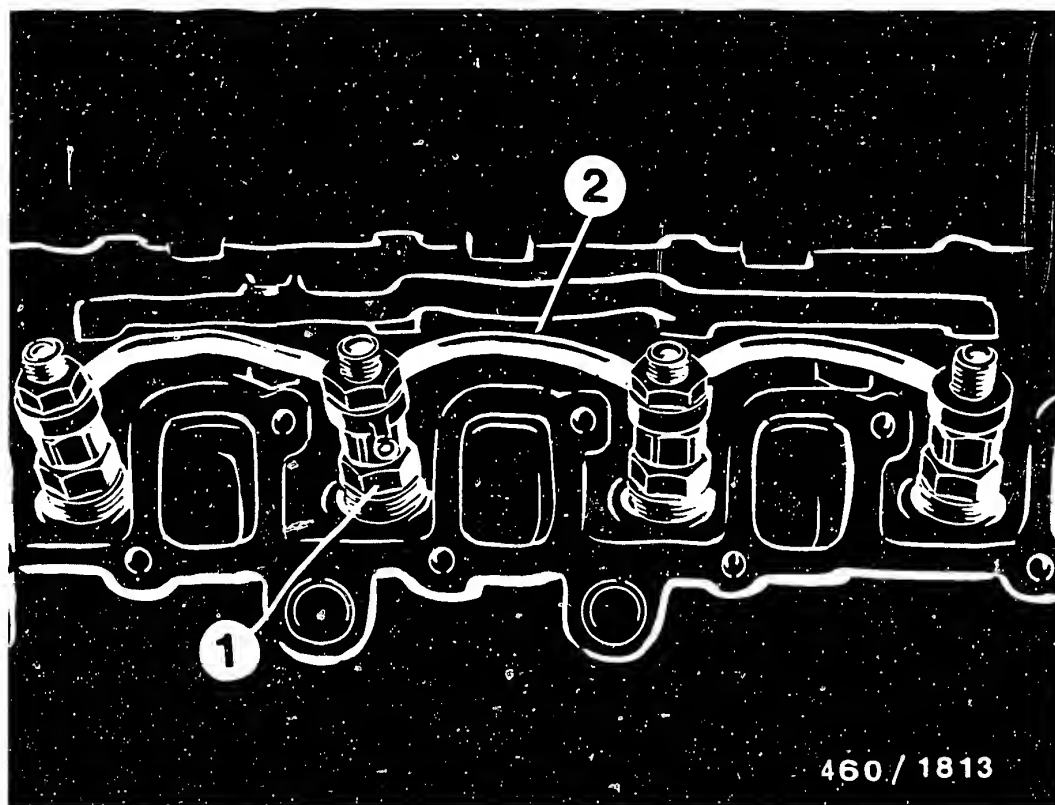
Requirement:

- \* Coolant temperature  $+20^{\circ}\text{C}$
- \* "Warm" idle speed O.K.

Measure clearance "A" between control lever and idle-stop screw.

Set value:  $A = 1.0\text{mm}$

If set value is not obtained, loosen lock nut and turn intermediate-lever adjusting screw until dimension "A" is obtained.



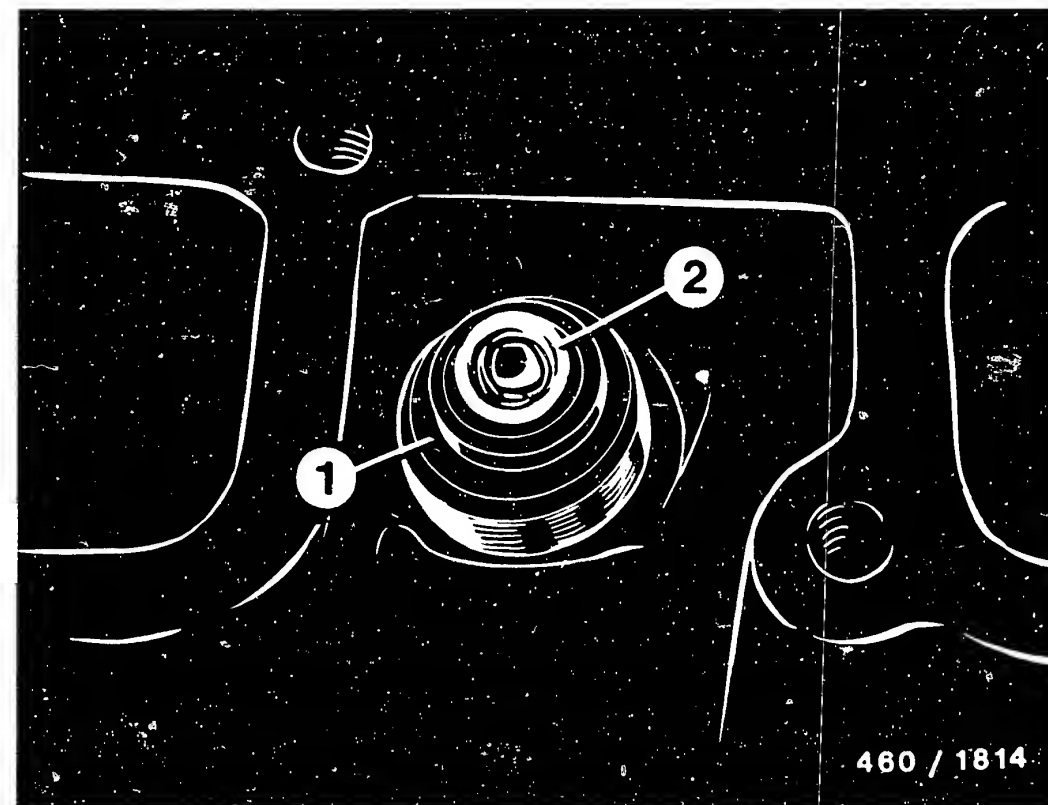
- 1 = Union nut  
2 = Return line, injection nozzle

#### REMOVE INJECTION NOZZLES

Remove fastening screws from intake manifold.

Remove fuel-return line from injection pump and return line from injection nozzles.

Loosen union nuts using commercially available socket wrench and remove nozzle-holder assemblies with union nuts.



- 1 = Thermal-insulation washer  
2 = Corrugated washer

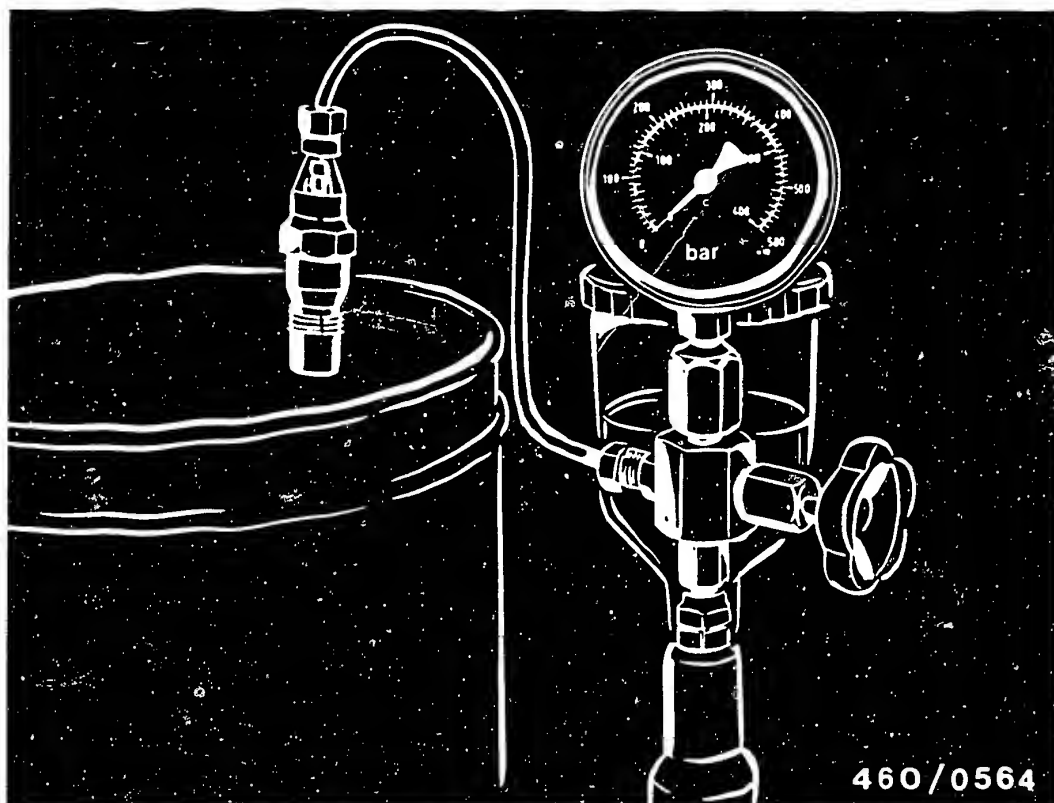
Remove thermal-insulation washer and corrugated washers.

Note:

To remove the thermal-insulation washer, remove cylinder head.

Drive out thermal-insulation washer downwards using brass mandrel.





## TEST INJECTION NOZZLES

The test is performed using the nozzle tester EFEP 60 H, 0 681 200 502.

Mount injection nozzle with nozzle-holder assembly on nozzle tester.

In order to make sure that the nozzle has not been clamped on incorrectly, operate the hand lever of the nozzle tester a few times forcefully with the pressure gauge switched off (approx. 4 to 6 downward movements/second).

## Notes:

When testing injection nozzles, make sure that the fuel spray does not strike your hands since, due to the high pressure, the fuel will penetrate into the skin and may cause blood poisoning.

For testing, use pure calibrating oil to ISO 4113 or clean diesel fuel.

Test criteria:

- \* Opening pressure
- \* Leakage
- \* Chatter behavior
- \* Spray pattern

Test the opening pressure

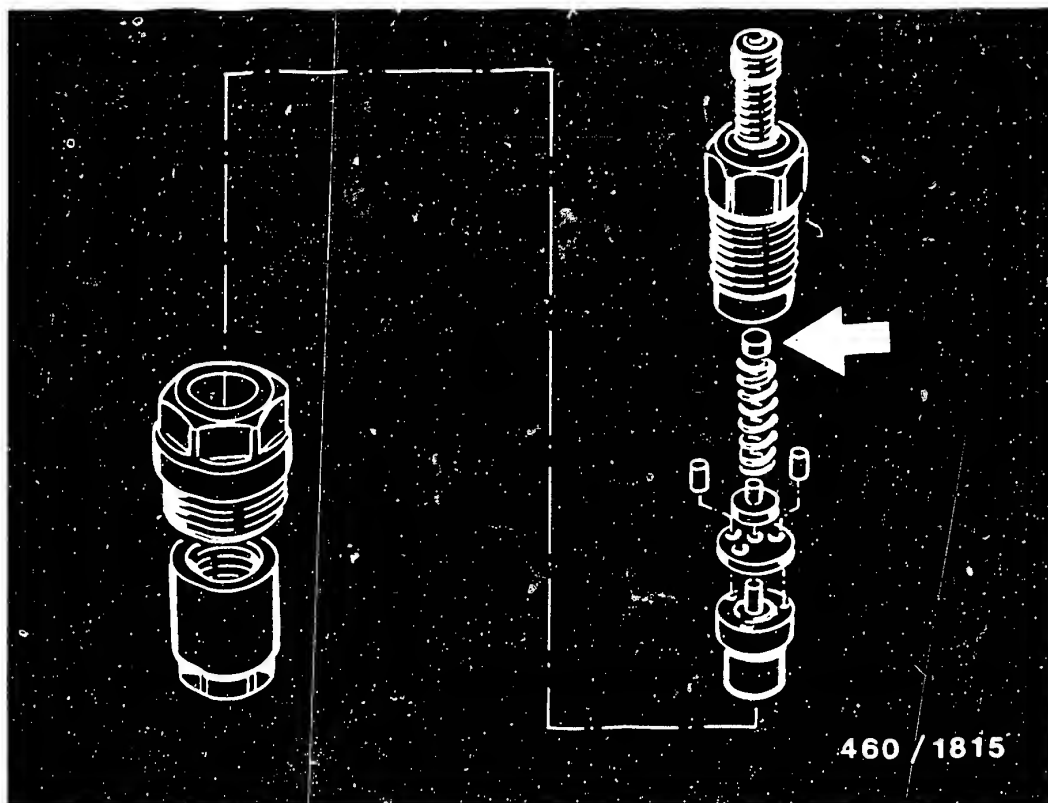
Open the spray-off valve at the pressure gauge approx. 1/4 rotation.

Slowly push down the hand lever of the nozzle tester (pressure increase at pressure gauge).

Observe the pressure at which the pointer of the pressure gauge maintains a steady position (nozzle does not chatter) or the pressure drops suddenly (nozzle chatters).

The highest pressure reached during this test is the opening pressure.





If different from the set value, correct the nozzle-opening pressure by means of shims behind the pressure spring in the nozzle holder.

See brief instructions for set value.

Thicker shims = higher nozzle-opening pressure  
Thinner shims = lower nozzle-opening pressure.

A  $\pm 0.05$  mm change of the spring travel results in a change of the nozzle-opening pressure of approx. 5.0 bar.

## Leakage test

Open the shutoff valve on the pressure gauge approx. 1/4 rotation.

Dry off the lower part of the nozzles and of the nozzle-holder assembly (blow dry with air).

Slowly push down the hand lever until the pressure gauge indicates 20 bar less than the opening pressure read off previously.

The nozzle is leak-tight if no drop falls from the the mouth of the nozzle within a period of 10 seconds.

If a drop does fall, disassemble and clean the nozzle-and-holder assembly.

If the nozzle continues to leak, replace it.

Reworking nozzle components is not permissible.

## Note:

Scoring on the supporting device and intermediate disc may be reworked, with necessary care being taken (during the warranty period).

## Chatter and spray tests

### Chatter test:

Thanks to its special constructional features, this nozzle chatters very softly. A chatter test with this nozzle is possible only at between 1...2 downward movements of the hand lever per second. If the test speed is increased, chattering ceases. The calibrating oil then escapes from the nozzle with a hissing noise. Only under abrupt, rapid movement of the hand lever (approx. 4...6 downward movements per second) does the nozzle chatter with a high whistling tone.

Spray test: (valid for new nozzles only)

Switch off pressure gauge.

At a low test speed, the greater part of the quantity of fuel delivered must be well atomized and must be injected through the side pre-spray hole without heavy streaking.

The main spray can be evaluated only if the hand lever is moved rapidly (approx. 4...6 downward movements per second).

The spray must be concentrated and well atomized.

## Chatter test, assessment of the spray pattern

### General:

When assessing the nozzles, differentiation must be made between new and used nozzles.

Switch off the pressure gauge.

### New nozzles:

The chatter test makes it possible to audibly test the freedom of movement of the needle valve in the nozzle body.

If the nozzle does not chatter despite having been cleaned, it must be replaced by a new nozzle.

The spray pattern is of no relevance for the chatter test.

Generally speaking, only new nozzles deliver a correct spray pattern.

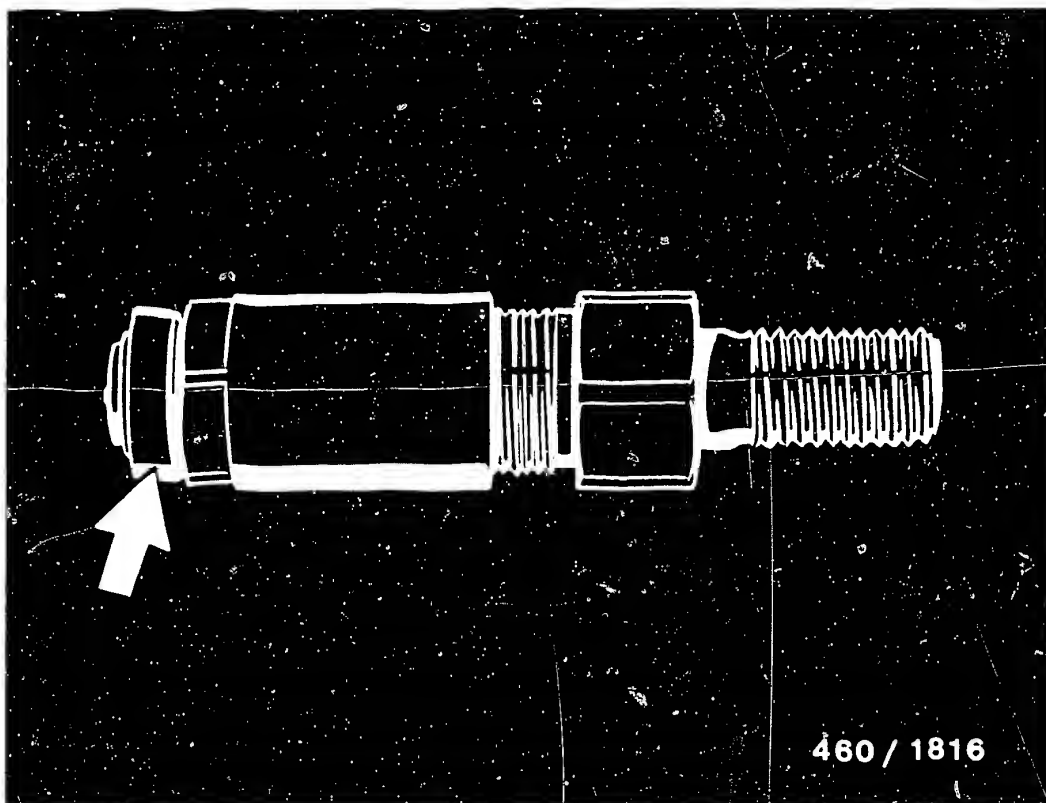
### Used nozzles:

Due to wear in the seat area of the nozzles, the chatter behavior of the nozzles deteriorates.

With quick actuation of the lever, the nozzles must chatter so that they can be heard and/or deliver a well atomized spray.

The spray pattern of used nozzles may deviate from the ideal pattern of a new nozzle.

If suitable cleaning measures are taken, the spray pattern of such nozzles may be noticeably improved.



### Install injection nozzles

Before installing the injection nozzles, insert a new heat-insulation washer for shielding and a tolerance compensator the right way round into the cylinder head.

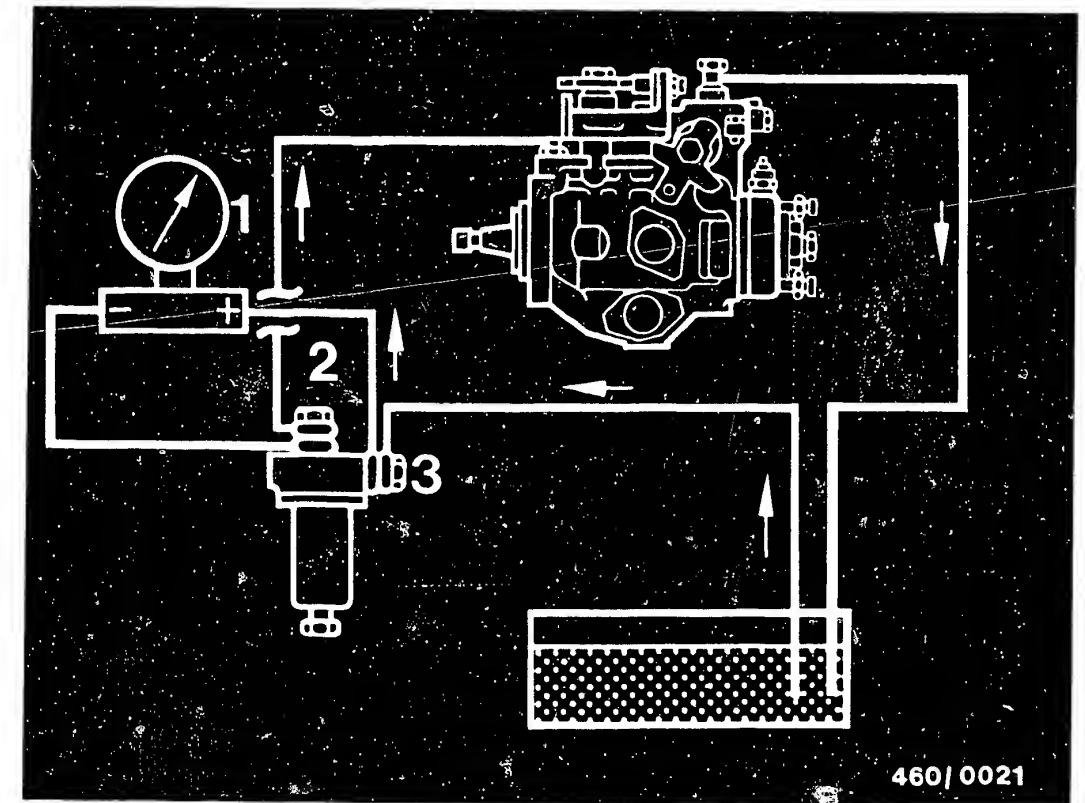
The collar side of the thermal-insulation washer must point upward.

Insert corrugated washer with the convex side facing upward.

Then screw nozzle-holder assembly with new nozzle seal ring (arrow) into cylinder head.  
(Observe tightening torque, see brief instructions).

#### Note:

If the tightening torque is exceeded, the nozzle needle may jam.  
Tighten union nuts of fuel-injection tubing to 25 Nm.  
Return to trouble-shooting chart B02



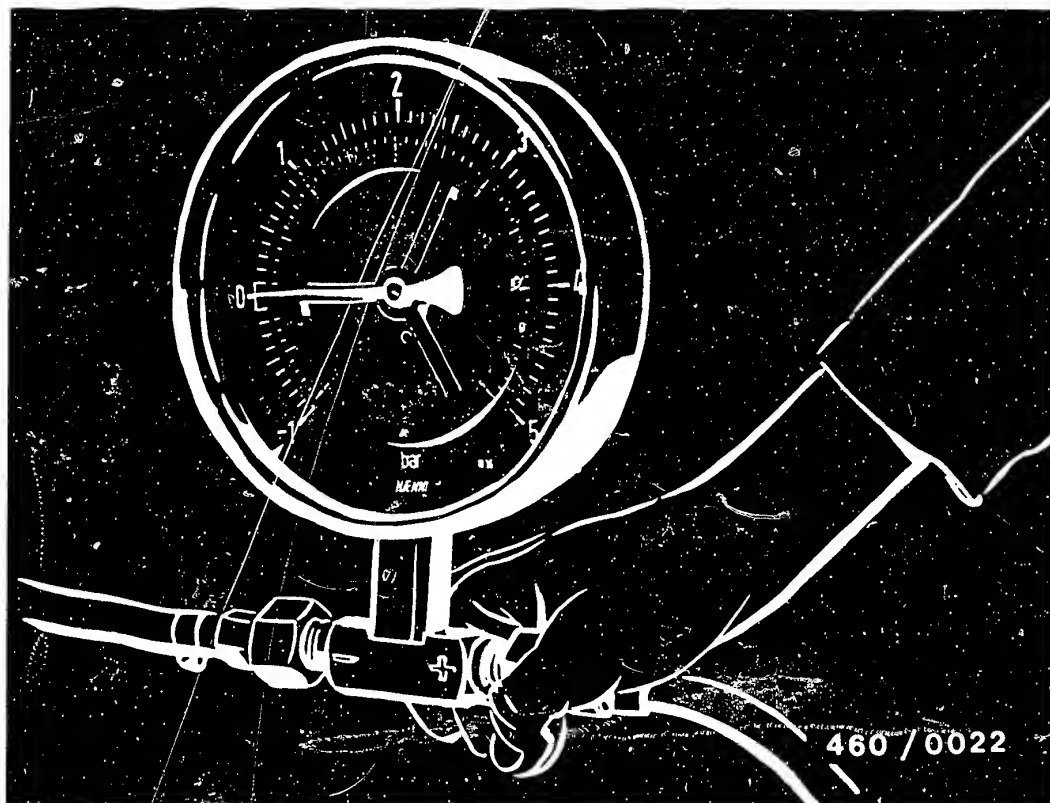
1 = Differential-pressure gauge

2 = Filter outlet  
(use inlet union and extra-long inlet-union screw 2 443 456 020)

3 = Filter inlet  
(use inlet union and extra-long inlet-union screw 2 443 456 020)

### CHECKING THE FUEL FILTER (DIFFERENTIAL-PRESSURE TEST)

Connect the differential-pressure gauge to the fuel filter using appropriate connecting pieces.

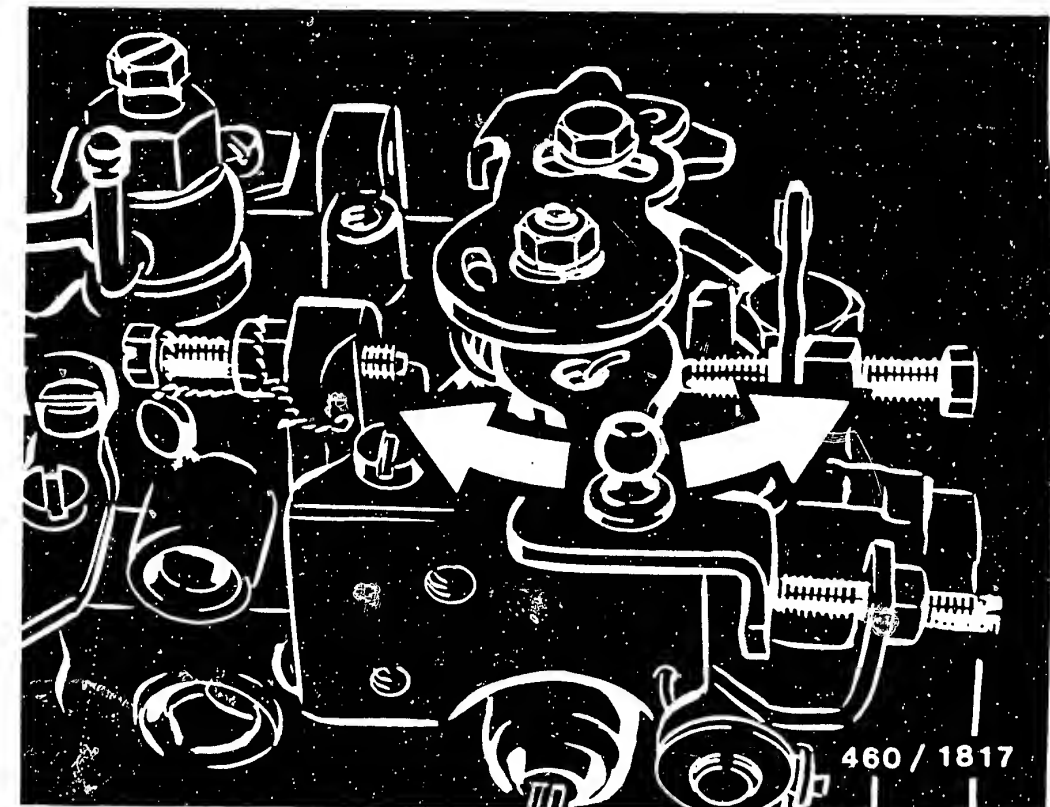


Connect the (+) side of the differential-pressure gauge to the fuel filter inlet.

Fit the (-) connection of the pressure gauge to the filter outlet.

See connection diagram.

Run engine until you are sure that there is no air in the fuel system.



Move engine-speed control lever approx. 1 second from idle stop to maximum-speed stop (arrows).

Release control lever and read off differential pressure at pressure gauge.

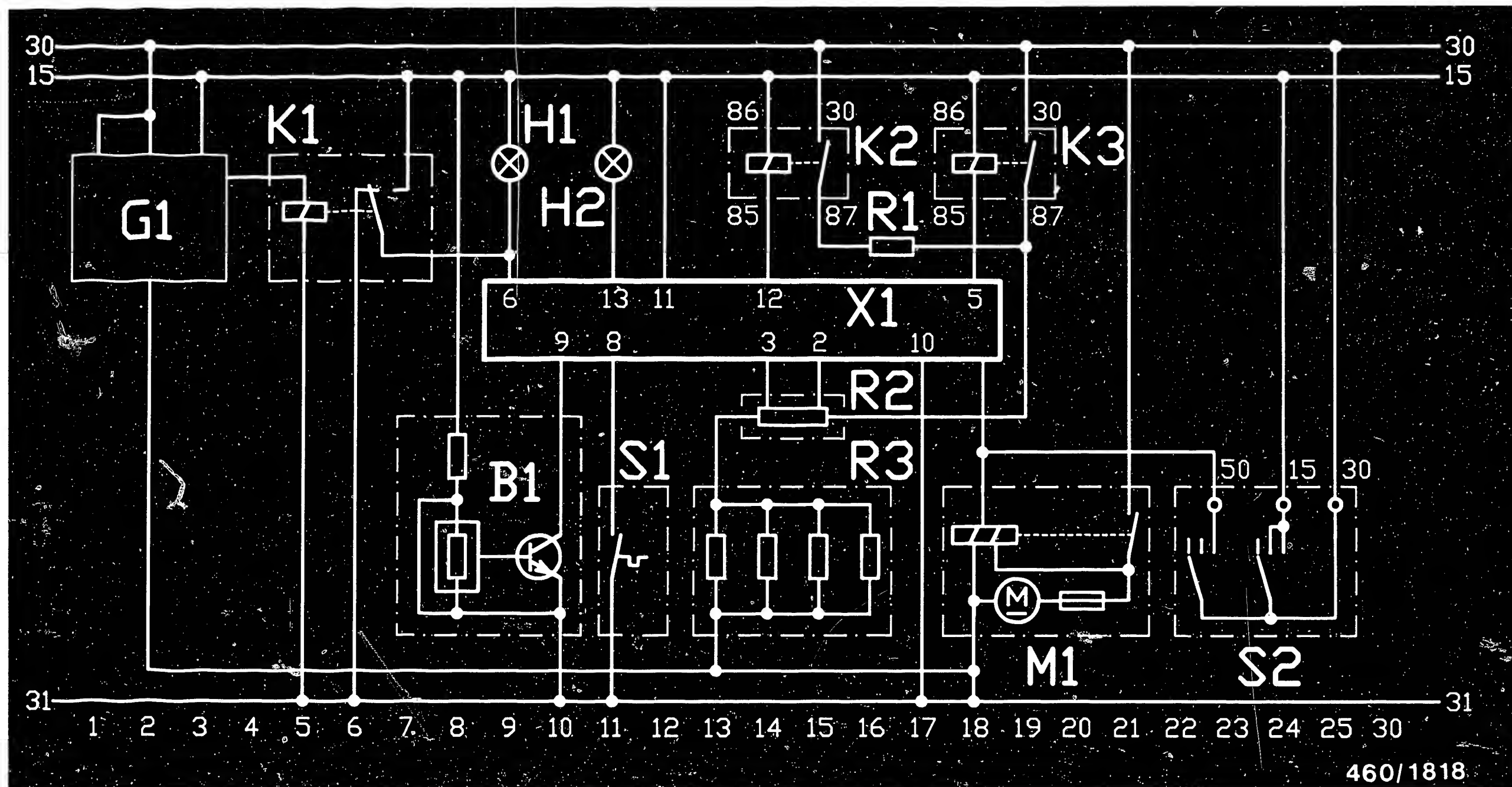
The differential pressure must be a maximum of 0.3 bar.

If this value is exceeded, replace filter.

Remove test connections.

If necessary, bleed air from fuel system.

Return to trouble-shooting chart B02



460/1818

B1 = Sensor (distance travelled)  
 G1 = Alternator  
 H1 = Charge indicator pump  
 H2 = Preheating-indicator lamp  
 K1 = Relay (charge indicator lamp)  
 K2 = Relay (series resistor)

K3 = Relay (measuring resistor)  
 M1 = Starting motor  
 R1 = Series resistor  
 R2 = Measuring resistor  
 R3 = Sheathed-element glow plugs

S1 = Switch, temperature sensor  
 (engine)  
 S2 = Ignition and starting switch  
 X1 = Glow-duration control unit

ELECTRICAL TERMINAL DIAGRAM - PREHEATING SYSTEM

C19

C20

# TESTIN PREHEATING SYSTEM 2

## Test requirements:

Battery O.K.

Compression O.K.

Fuel supply and

injection system O.K.

N>

\*Check leads from glow-duration control unit to sheathed-element glow plugs for open circuit.  
Eliminate open circuit.

\*Check lead from battery (+) to glow-duration control unit for open circuit.  
Eliminate open circuit.

\*Check ground cable from glow-duration control unit term. 31 for open circuit.

If points O.K., replace glow-duration control unit.

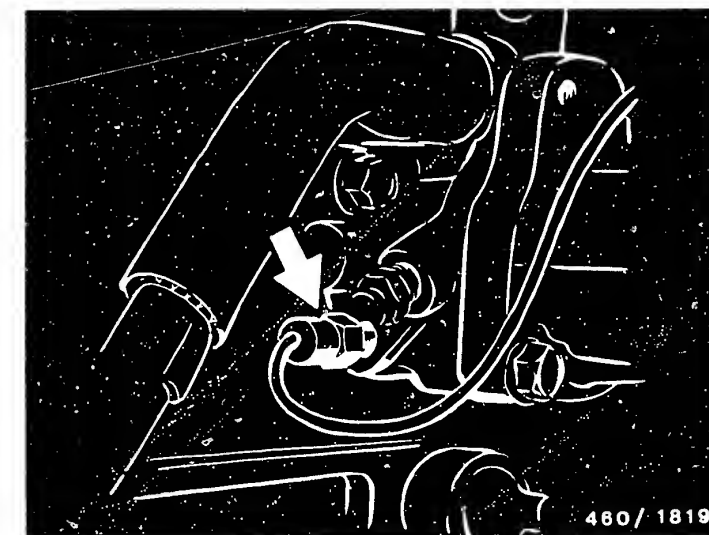
Test voltage supply to sheathed-element glow plugs.

N>

Connect voltmeter to sheathed-element glow plugs in turn and to ground.

Unclip thermo-switch from water-outlet fitting of the thermostat.

Set glow-plug and starter switch to position 2; preheating-indicator lamp lights up for approx. 3.5 s. Voltmeter indicates voltage supply for 7s.



Arrow = Thermo-switch

Continued on next picture page

# TESTIN PREHEATING SYSTEM 3

V

## Test preheating duration

Connect voltmeter to one sheathed-element glow plug and to ground.

Set glow-plug and starter switch to position 2.

Preheating-indicator lamp lights.

After a specific preheating duration, the preheating-indicator lamp lights up depending upon the ambient temperature.

Voltmeter must indicate voltage for 7 s.

After the specified time has elapsed, the voltmeter must indicate 0 V.

Voltmeter after the specified time at 0 V?

N>

Check following wiring-harness connections for open circuit, loose plug-in connections, and short circuit:

- \* Battery
- \* Sheathed-element glow plugs
- \* Glow-plug and starter switch
- \* Glow-duration control unit
- \* Ground terminal

Y

V

Continued on next picture page

# TESTIN PREHEATING SYSTEM 4

Test glow relays 1 and 2.

Installation position: behind glove compartment.

Connect ohmmeter between term. 30 and term. 87 (measuring-resistor relay and series-resistor relay).

Set value: infinity  $\Omega$

Set glow-plug and starter switch to position 2.

Measure resistance with battery voltage applied to term. 85 and term. 86, and to term. 30 and term. 87.  
Set value: 0  $\Omega$

N>

Replace measuring-resistor/series-resistor relay.

Test thermo-switch.

Disconnect thermo-switch and remove.  
Heat up thermo-switch in water bath and determine switching characteristics using ohmmeter.

Cut-in point : 57...63° C •  
Switch-off point : min. 53° C

N>

Replace thermo-switch.

Note:  
When installing the thermo-switch, apply sealing compound (in accordance with Opel documentation) to screw thread.

Arrow = Thermo-switch



460 / 1819

Continued on next picture page



TESTIN PREHEATING SYSTEM 5



Test series resistor.

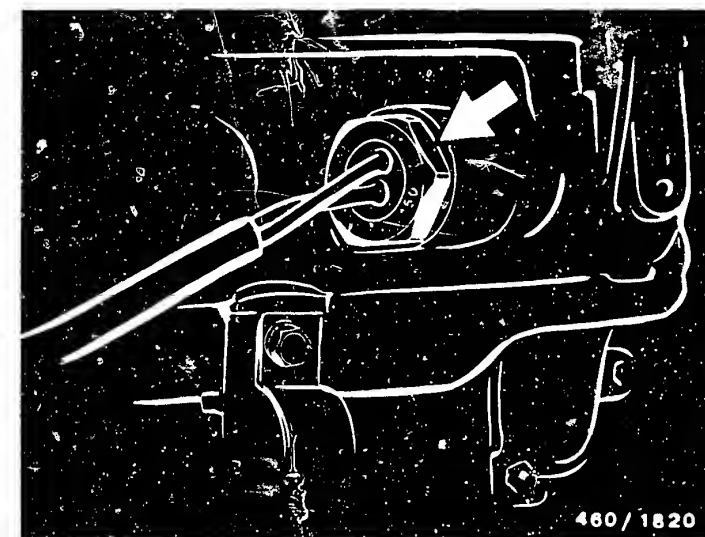
Installation position: behind air-  
filter housing on intake manifold.

Connect ohmmeter to series  
resistor.

Set value: 150  $\Omega$

N>

Replace series resistor.



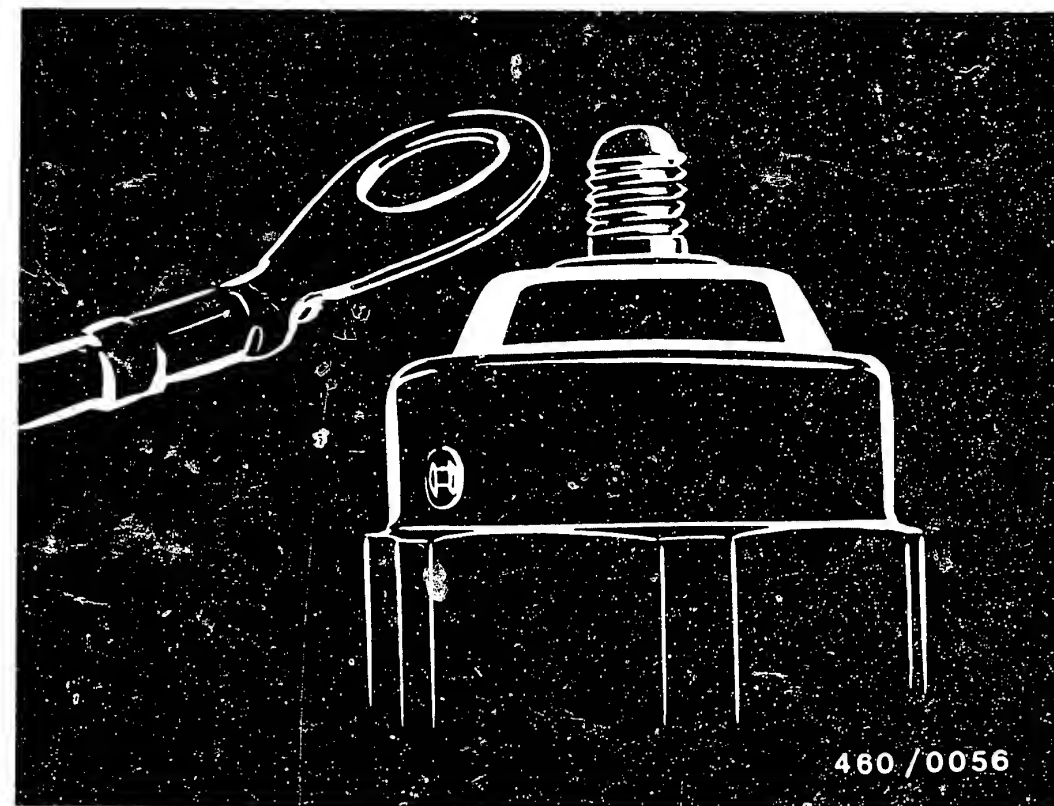
Arrow = Series resistor

## CHECK TIMING DEVICE

In the distributor-type fuel-injection pumps VE..F., the timing device is integral with the fuel-injection pump.

In order to test the timing device, it is necessary to remove the fuel-injection pump.

Perform the test on the injection-pump test bench.



## MEASURE ENGINE COMPRESSION AND COMPRESSION LOSS

Measure engine compression

Fit new chart in compression tracer.

Mount high-pressure hose on tracer.

Switch off engine.

In order to prevent fuel from being injected, remove connecting cable from shutoff solenoid on distributor-type fuel-injection pump (illustration).

Unscrew sheathed-element glow plugs and use suitable connecting nipple for compression tester.

With the aid of the starting motor, turn the engine over several times so that loose deposits are removed from the compression chamber.

Screw in connecting nipple.

Mount high-pressure hose of compression tester to connecting nipple.

During the following operation, pay particular attention to the first compression stroke.

Operate starting motor until there is no longer any detectable pressure rise on the compression tracer.

Bleed compression tracer by pressing on bleed valve.

The pointer returns to the starting position.

Move chart into next position.

Mount connecting nipple on following cylinders and repeat measurement.

Compression pressure:  
for set values, see brief instructions

Allowable difference between cylinders:  
for set values, see brief instructions.

## Evaluation of the chart

### Normal pressure rise:

If the piston rings and valves are in good condition, the first compression stroke shows the highest pressure increase.

During the following compression strokes, the compression builds up to the maximum pressure.

### Gradual pressure rise:

If, from the start, the compression increases only gradually on each piston stroke, this points to burnt valve seats or defective valve guides.

### Low maximum pressure:

If the maximum pressure obtained is too low on all cylinders, this points to defective pistons, piston rings or valves.

If the compression is too low on two neighbouring cylinders, this points to a leaky cylinder-head gasket.

### Varying compression

If one cylinder shows a clearly lower compression, proceed as follows:

Fill in 2...3 cm<sup>3</sup> of engine oil through the opening of the sheathed-element glow plug or nozzle-holder assembly and operate the starting motor briefly.

Repeat measurements and compare the charts.

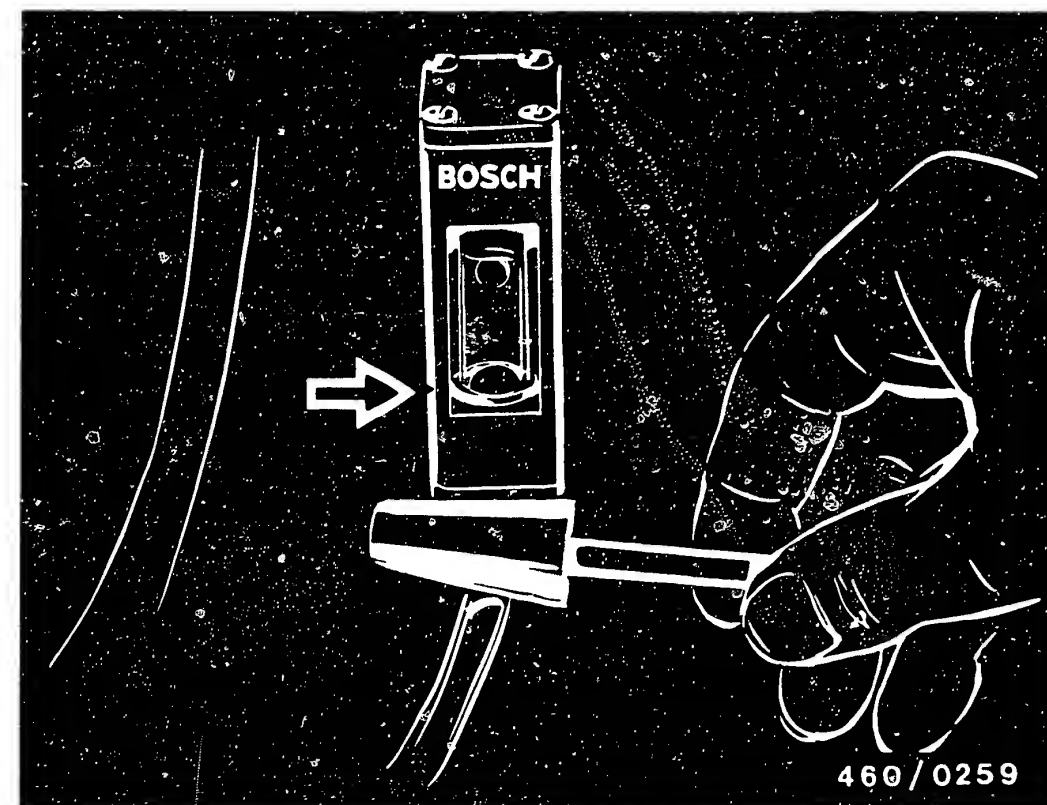
If there is a clear increase in compression during the second test, then the piston rings or cylinders are worn.

If there is no change in the result, then defective valves are the cause.

### Uniform compression

Uniform compression is extremely important with regard to the smooth running of the engine.

Maximum compression is, therefore, not the only object.



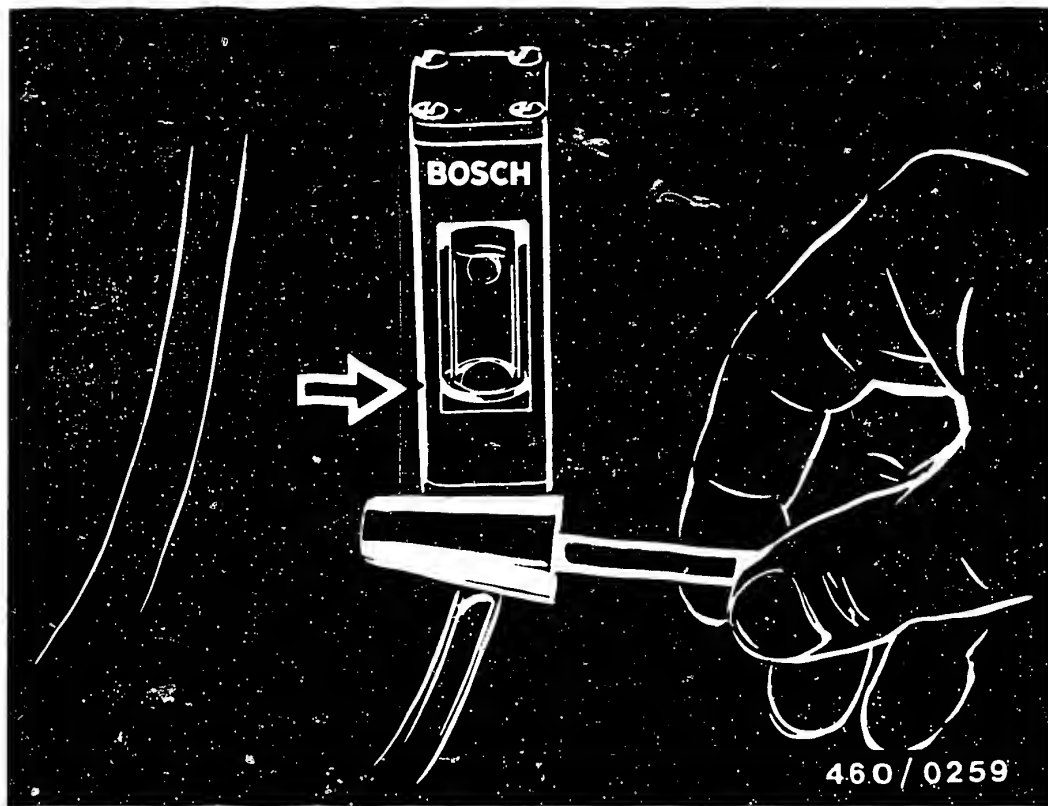
### Measuring the compression loss of the engine

The test is performed using the  
BOSCH compression-loss tester 0 681 001 901  
(EFAW 210 A)

For testing, the respective piston must be at TDC (TDC = top dead center) on the compression stroke.

For setting this position, use the DC detector 1 688 132 025 (included in accessories with the compression-loss tester).

Perform the test with the engine at normal operating temperature (water temperature approx. 80° C).



#### Setting top dead center

Remove the sheathed-element glow plug from cylinder 1.

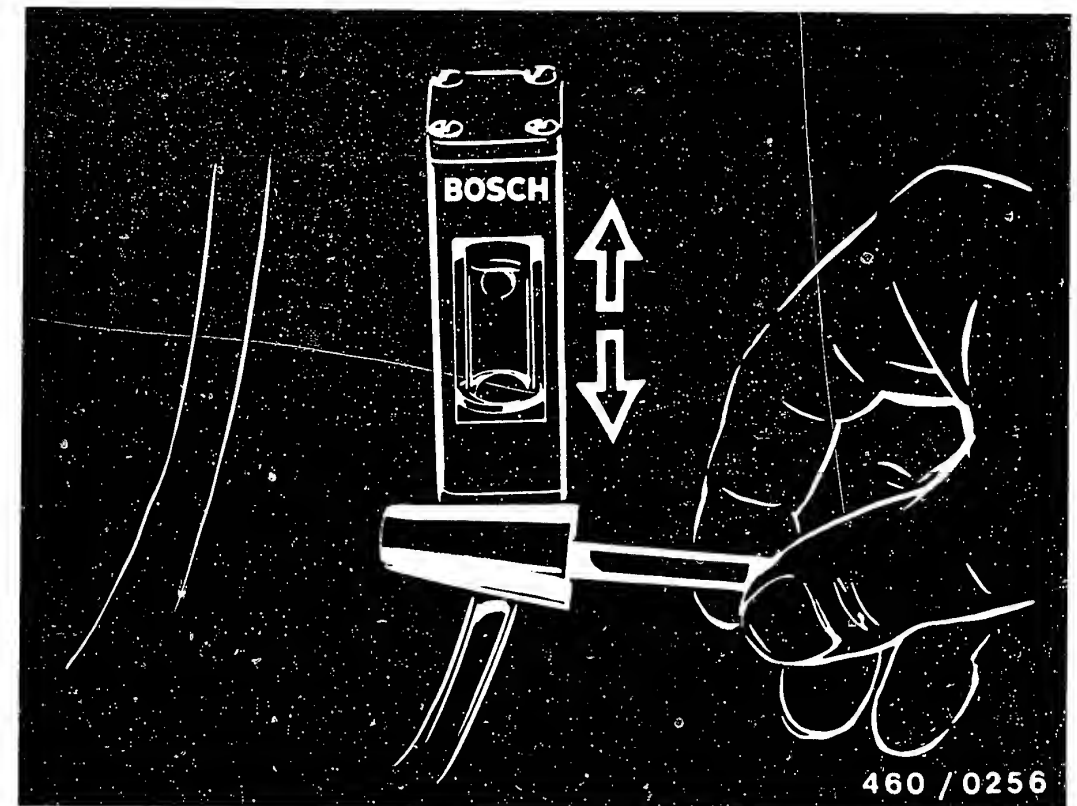
Insert the rubber plug of the DC detector into the bore for the sheathed-element glow plug.

Using a magnetic clamp, mount the glass cylinder in as vertical position as possible in the engine compartment.

The piston of the unit must be easily visible.

Slowly turn the engine over by hand in its direction of rotation.

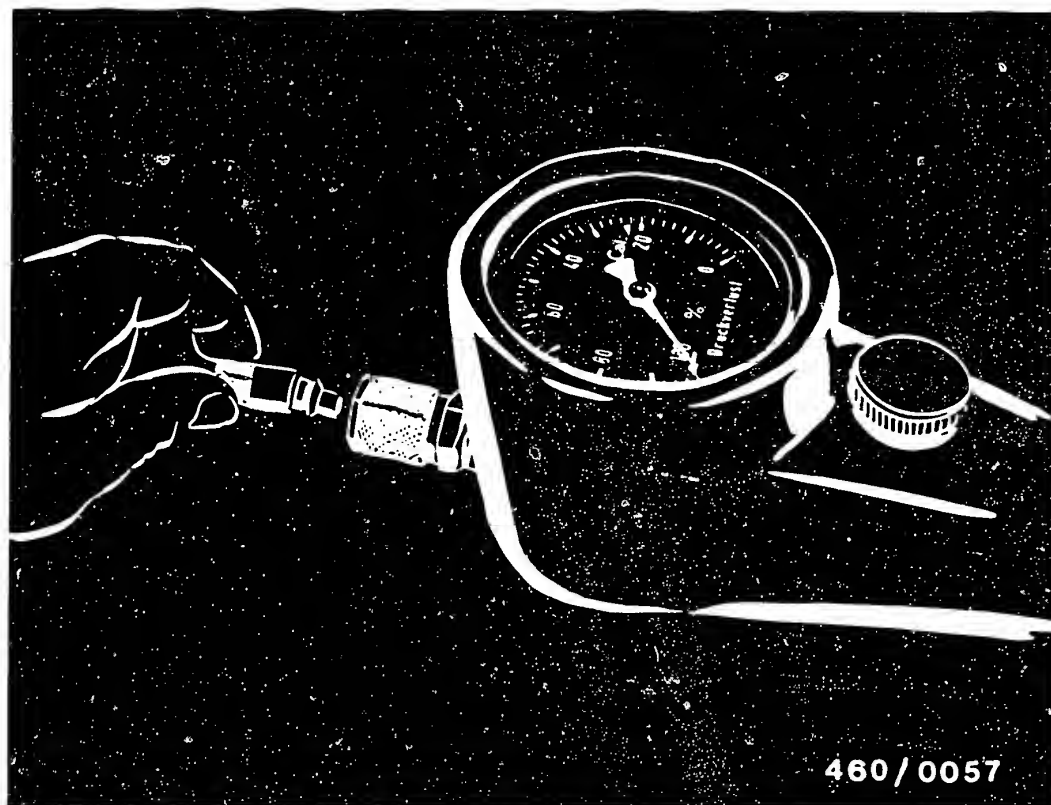
(If necessary, select a gear and push vehicle).



On the compression stroke, the piston of the DC detector is forced upwards.

As top dead center is passed over, the piston slides down again immediately.

Locate top dead center by carefully turning the engine backwards and forwards.



460/0057

Measure the compression loss

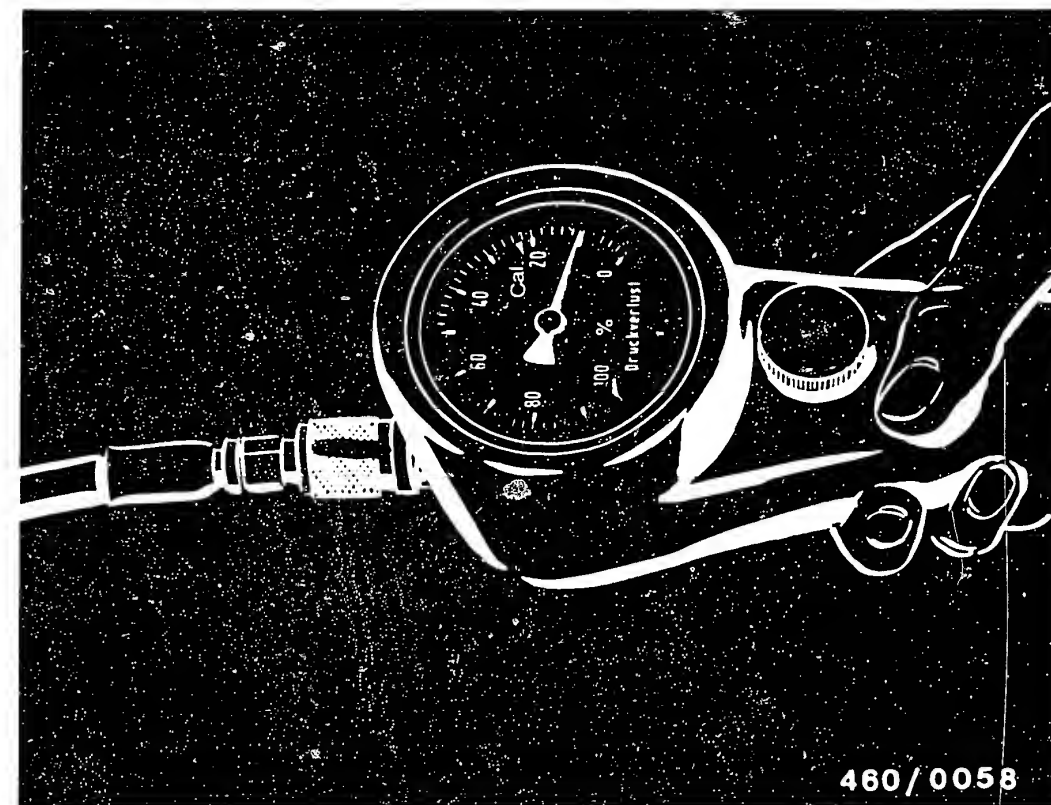
Connect the tester to the compressed-air mains.

Connect the calibrating nozzle 1 680 363 036.

Set a compression loss of  $23 \pm 1\%$  (marking "Cal.") at the knurled thumbscrew on the pressure-regulating valve.

The instrument indicator may deviate from the zero point by plus/minus one scale mark.

If this is not the case, the tester is defective.



460/0058

Screw in the fitting and mount the test hose.

Select a gear and pull on the handbrake.  
Connect the test hose to the tester.  
Read off the compression loss in % on the instrument.

Note:

Before testing the next cylinder, turn the engine over briefly without preheating using the starting motor so that the oil film reforms.

## Evaluation of the test

The compression loss indicated should not exceed 25%.

Differences of 10 % between the individual cylinders can be ignored.

The causes of greater losses can be located, because the air makes a noise as it escapes.

Listen at the following points:

Location of noise	Possible trouble
Intake manifold (Remove air filter)	Intake valve
Exhaust manifold	Exhaust valve
Oil filler neck on engine	Pistons/piston rings
Cooling water filler neck (air bubbles)	Cylinder-head gasket

In order to trace the trouble even more accurately, fill approximately 2...3 cm<sup>3</sup> of engine oil into the cylinder.

Repeat the test.

If there is a clear decrease in compression loss during this test, then the fault lies with the piston or with the piston rings.

New engines which have not yet been run in (less than 5 000 km) may show higher compression losses than after the running-in period.

Return to trouble-shooting chart 804

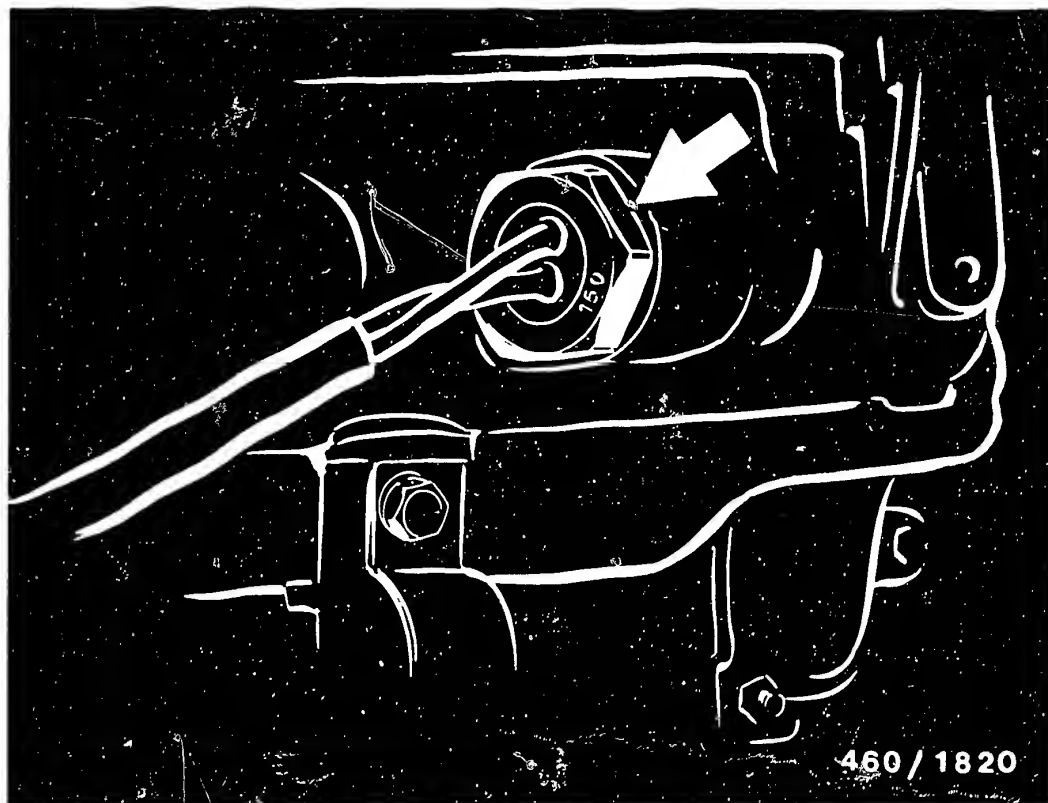


1 = Air-intake hose, air filter

2 = Hose, crankcase breather

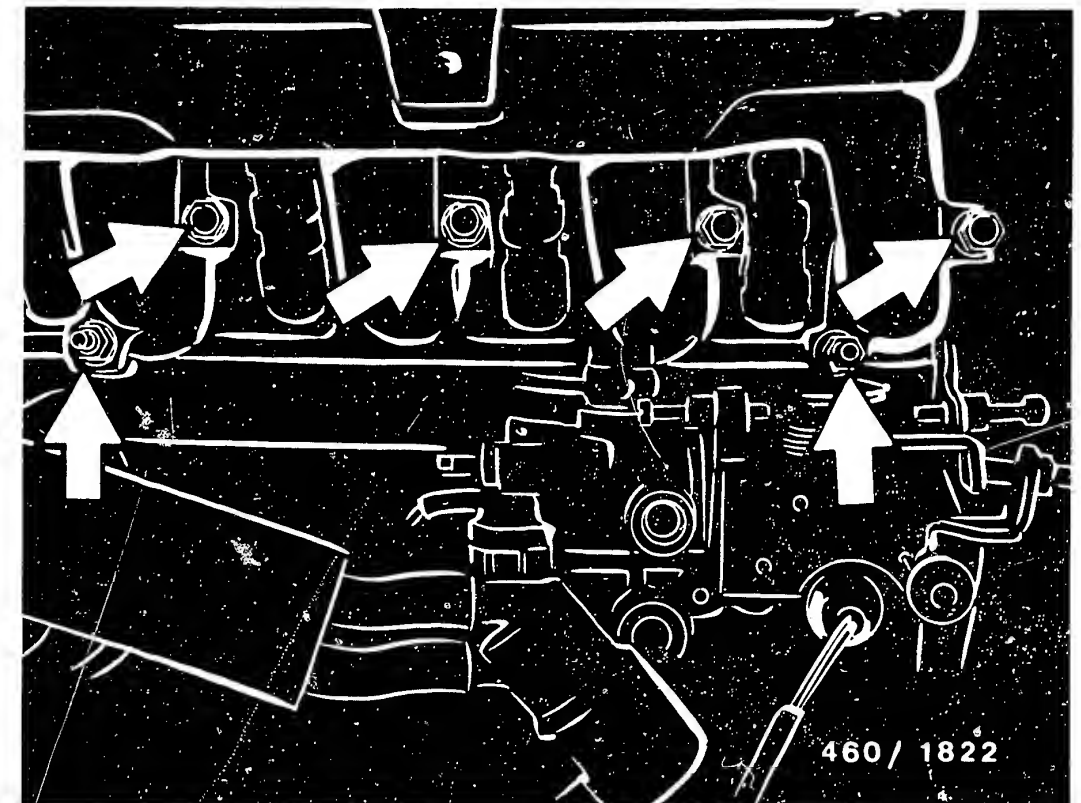
## REMOVE FUEL-INJECTION PUMP

Disconnect negative cable from the battery.  
Remove air-intake hose from air filter.  
Remove crankcase breather and unscrew vacuum hose from air filter.



Arrow = Series resistor

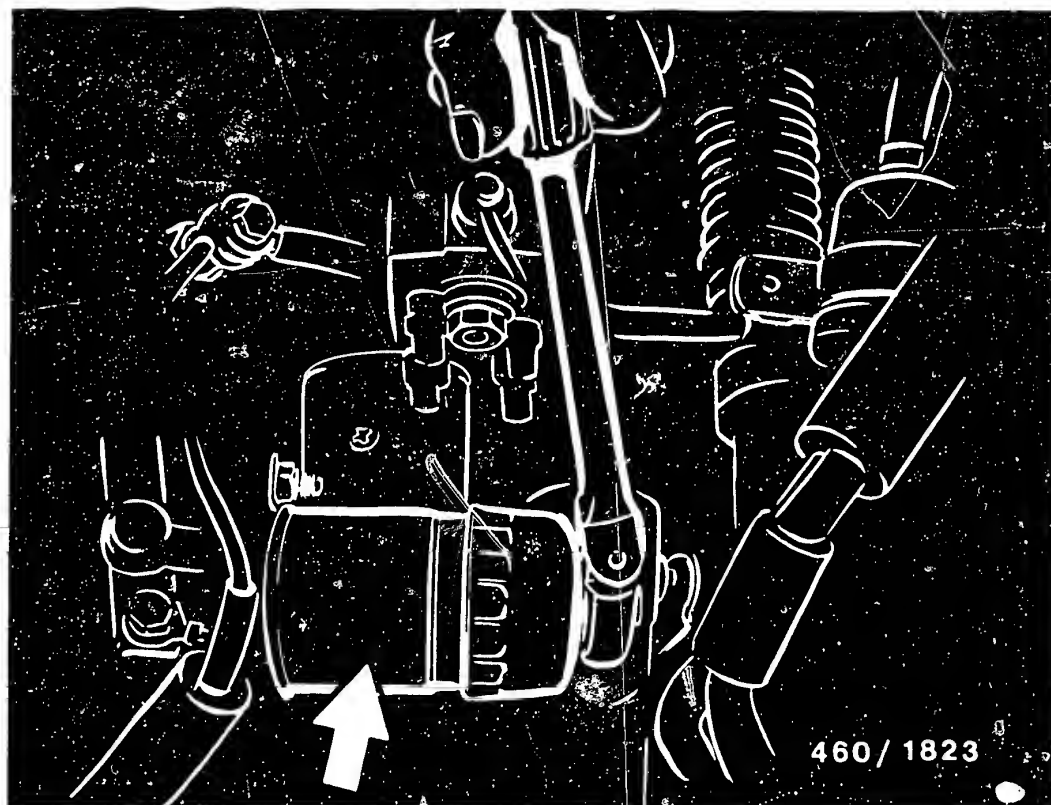
Disconnect lead to series resistor.  
Unscrew fuel filter.



Remove fastening bolts of intake manifold  
(arrows).

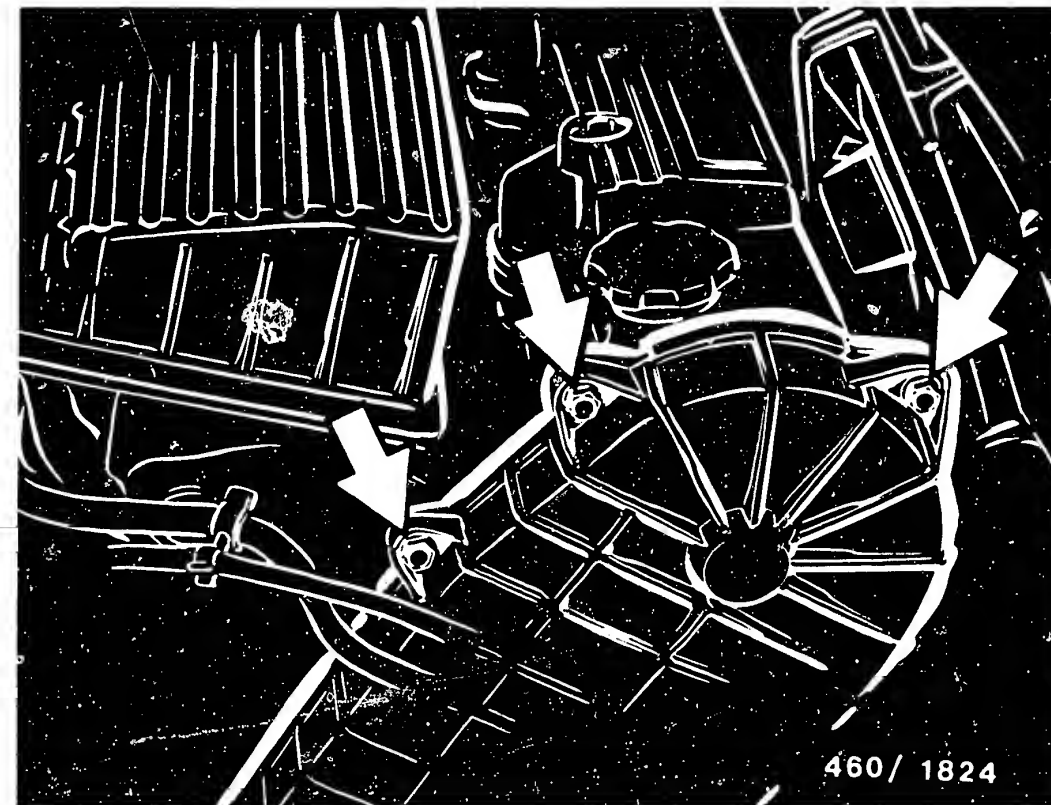
Remove intake manifold with air-filter  
housing.





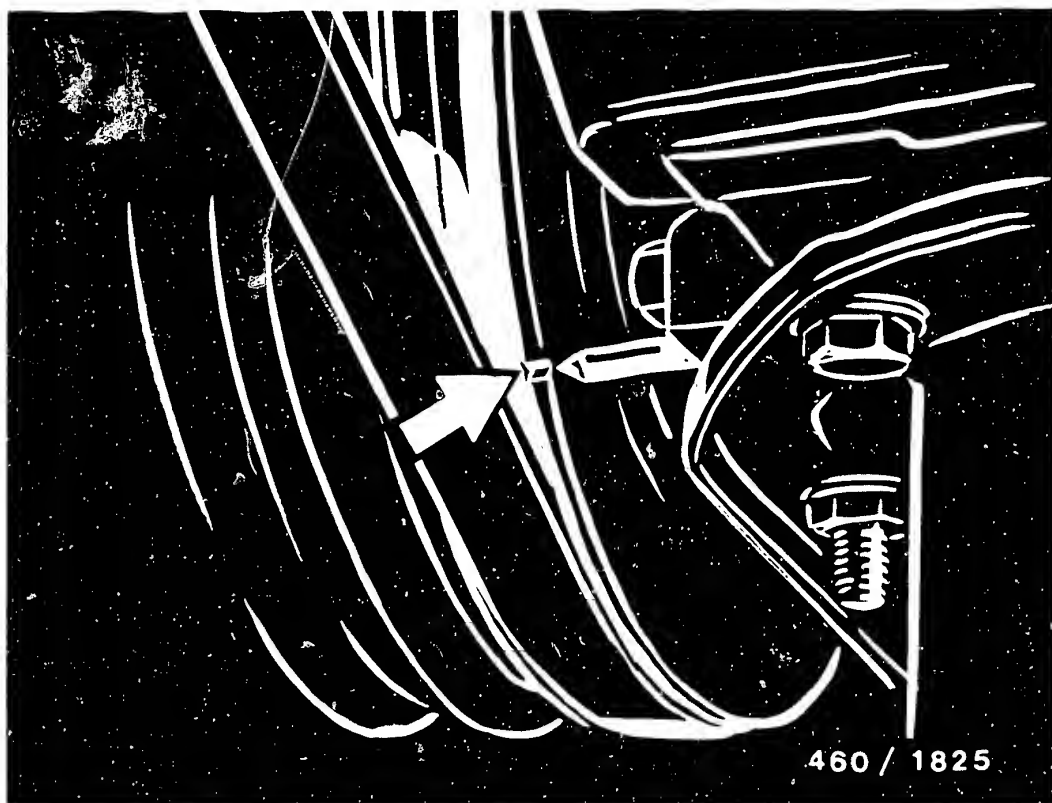
Arrow = Oil filter

Unscrew oil filter using commercially available tool.  
Unscrew vacuum-line bracket and connecting lead of alternator.



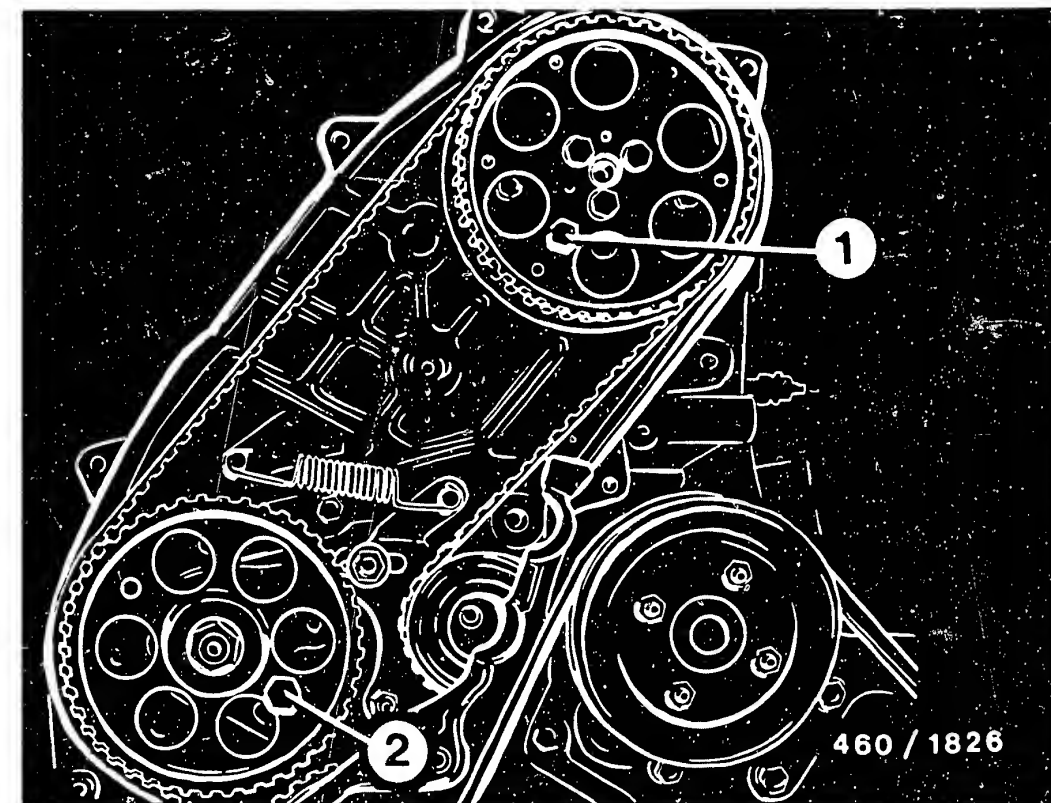
Remove cooling-water hoses from the upper toothed-belt cover.

Remove upper toothed-belt cover (arrows).



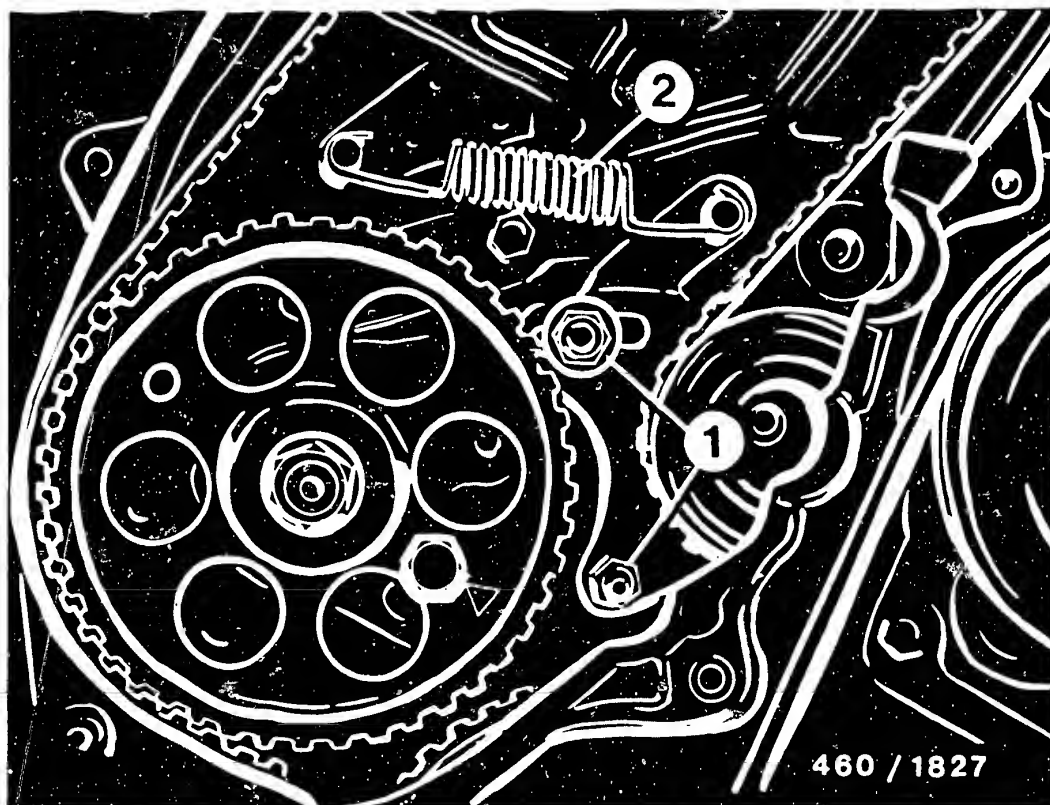
Turn crankshaft in the direction of engine rotation until the marking of the crankshaft pulley aligns with the pointer on the engine block.

The piston of cylinder 1 is at TDC, the valves of cylinder 4 are on overlap.



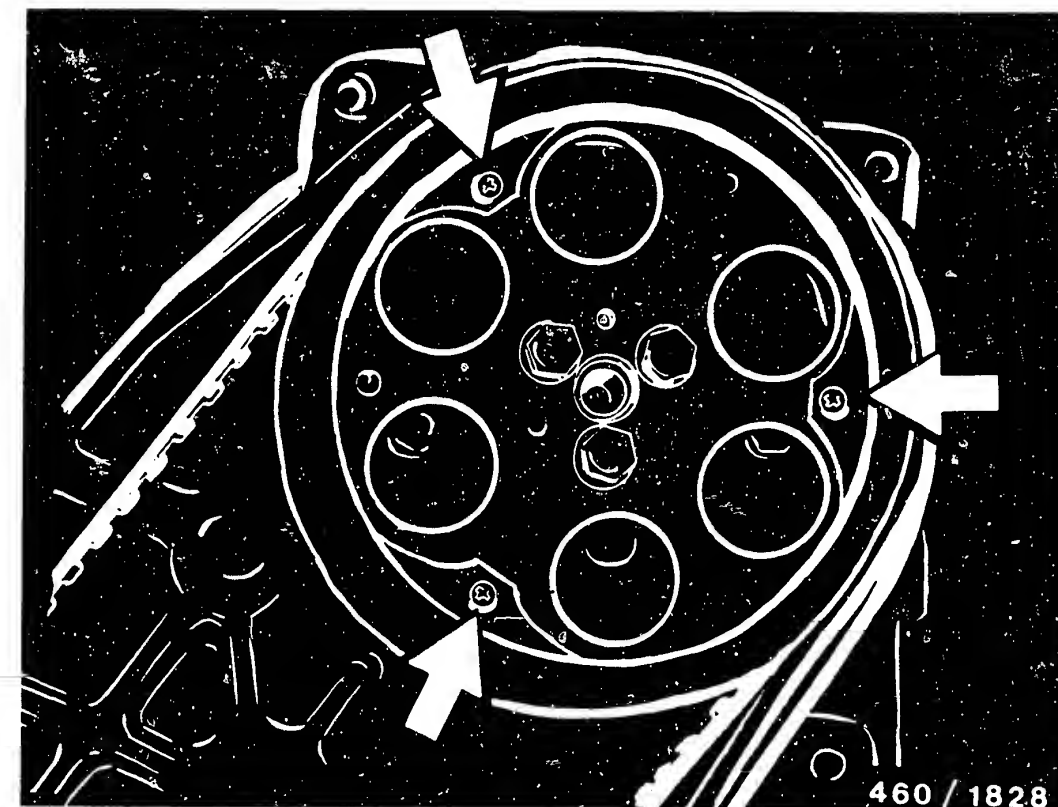
- 1 = TDC locking screw of camshaft gear,  
M6 thread
- 2 = TDC fastening nut of injection-pump gear,  
M8 thread

In this position, screw TDC locking screws into camshaft gear and injection-pump gear.

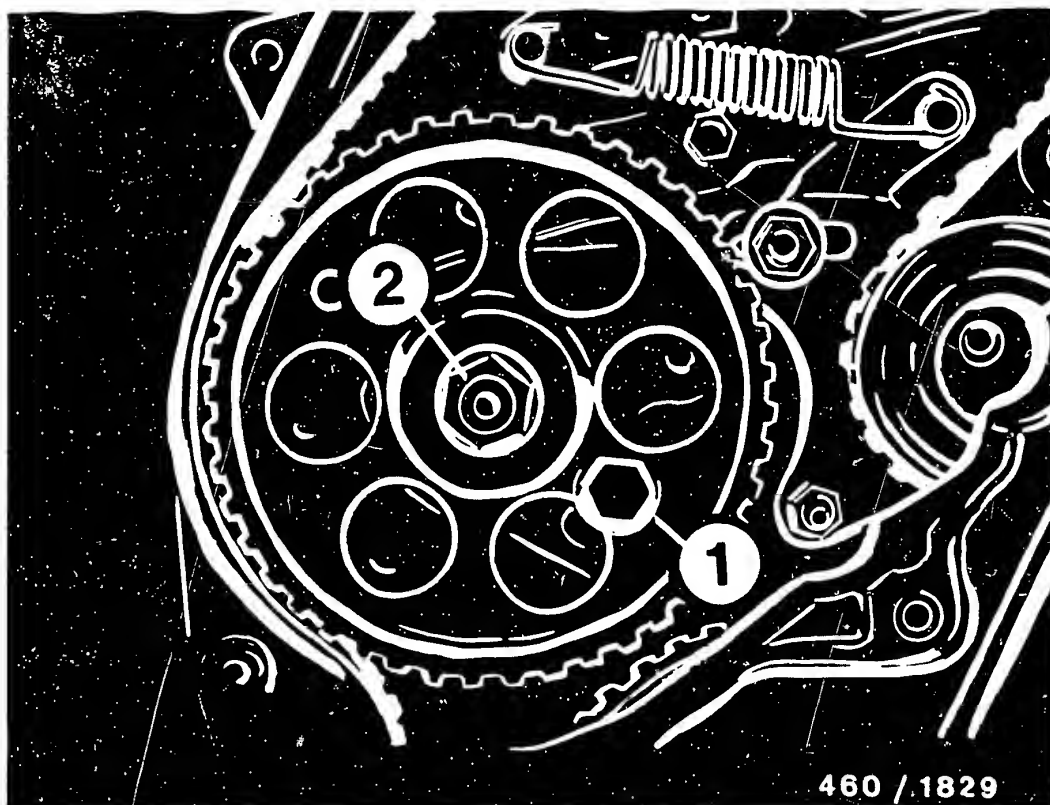


- 1 = Tensioning-roller mounting bolts  
2 = Extension spring

Loosen tensioning-roller mounting bolts and unhook extension spring.



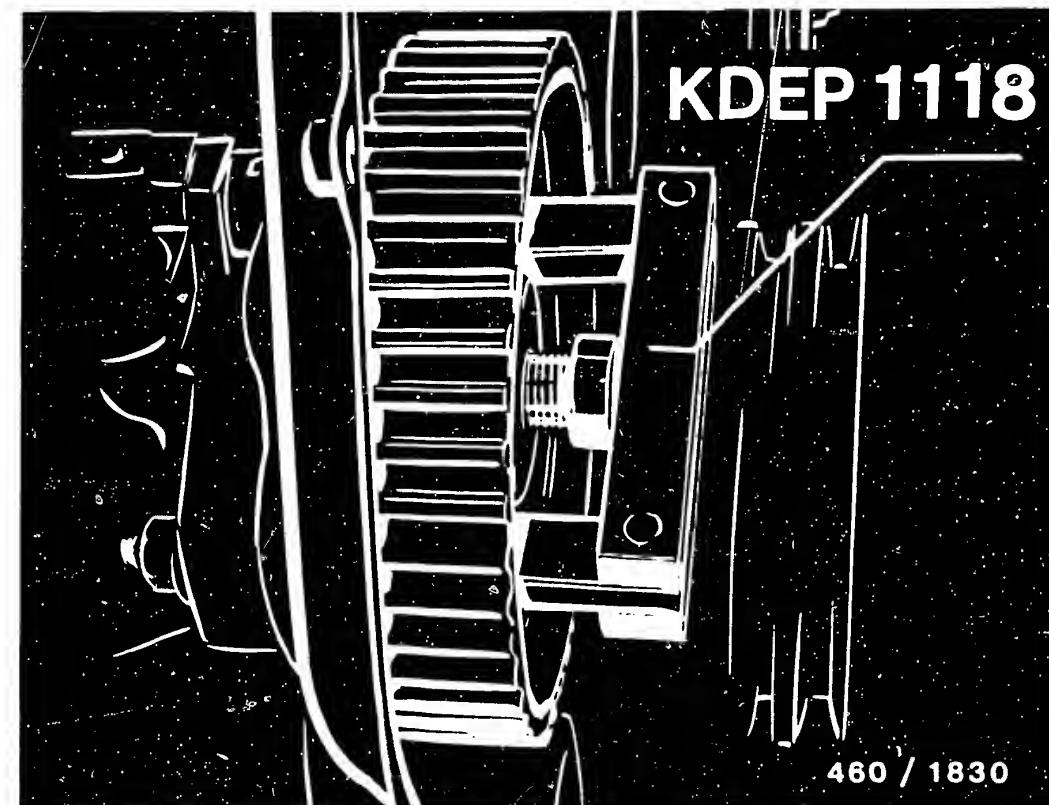
Unscrew toothed-belt guide plate from camshaft drive gear (arrows) and remove toothed belt.



1 = TDC locking screw  
2 = Fastening nut

Remove fastening nut from injection-pump gear.

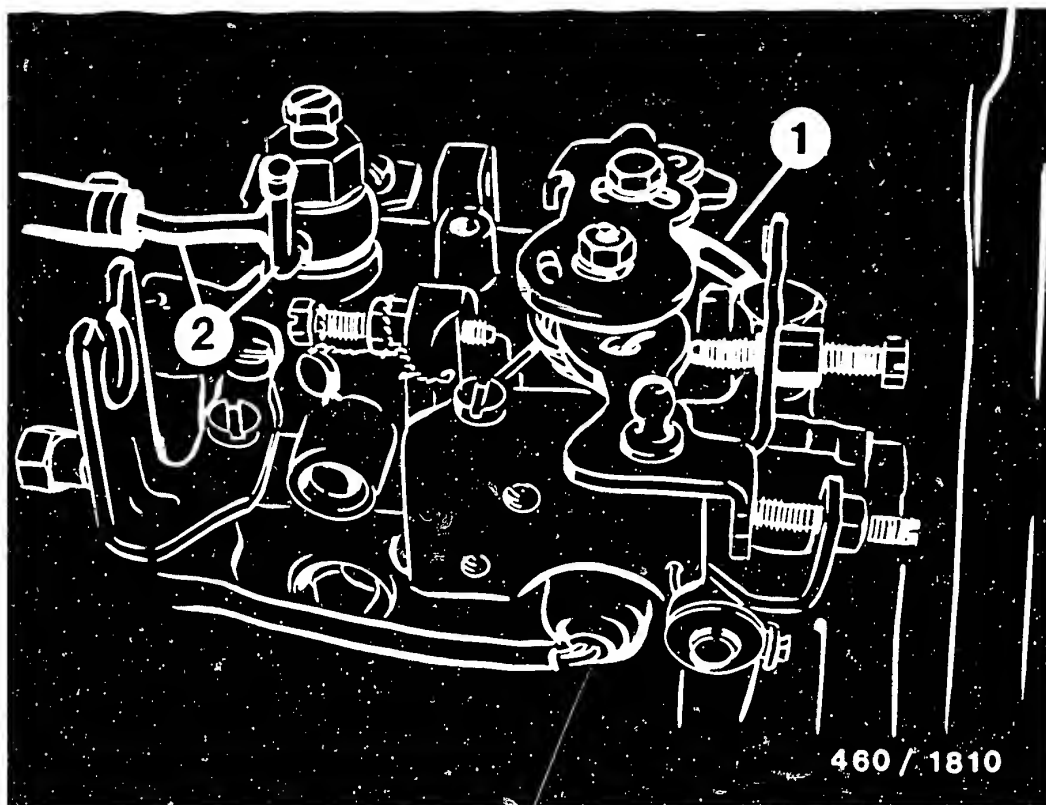
Unscrew TCD locking screw.



Attach puller KDEP 1118 to injection-pump gear.

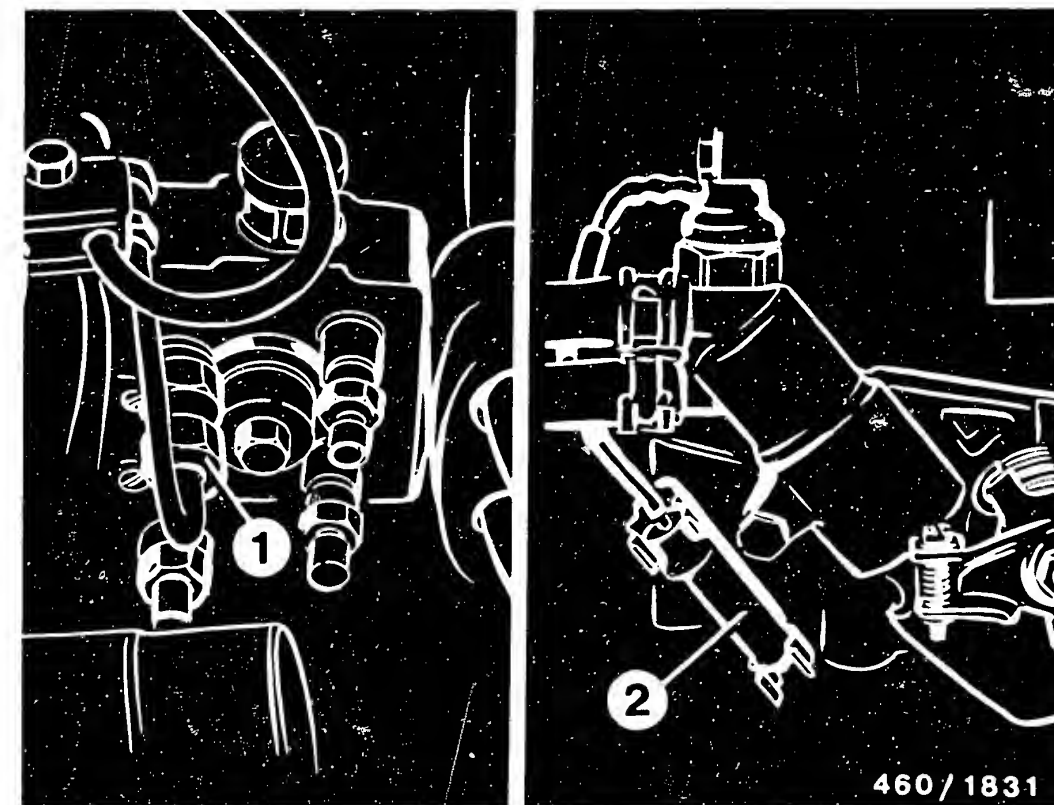
Loosen pump-drive gear from injection-pump drive shaft.

Remove puller KDEP 1118.  
Remove injection-pump gear.



- 1 = Fuel-inlet line
- 2 = Fuel-return lines

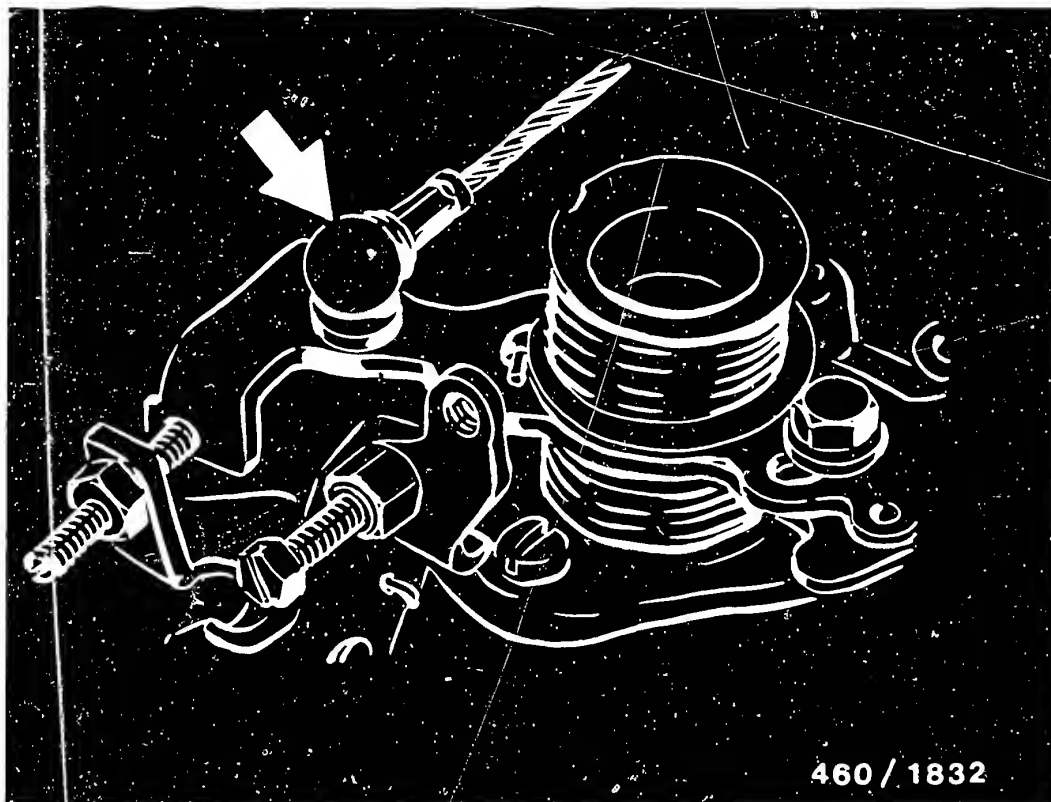
Remove fuel-inlet line and fuel-return lines from injection pump.



- 1 = Fuel-injection tubing
- 2 = Plug-in connection

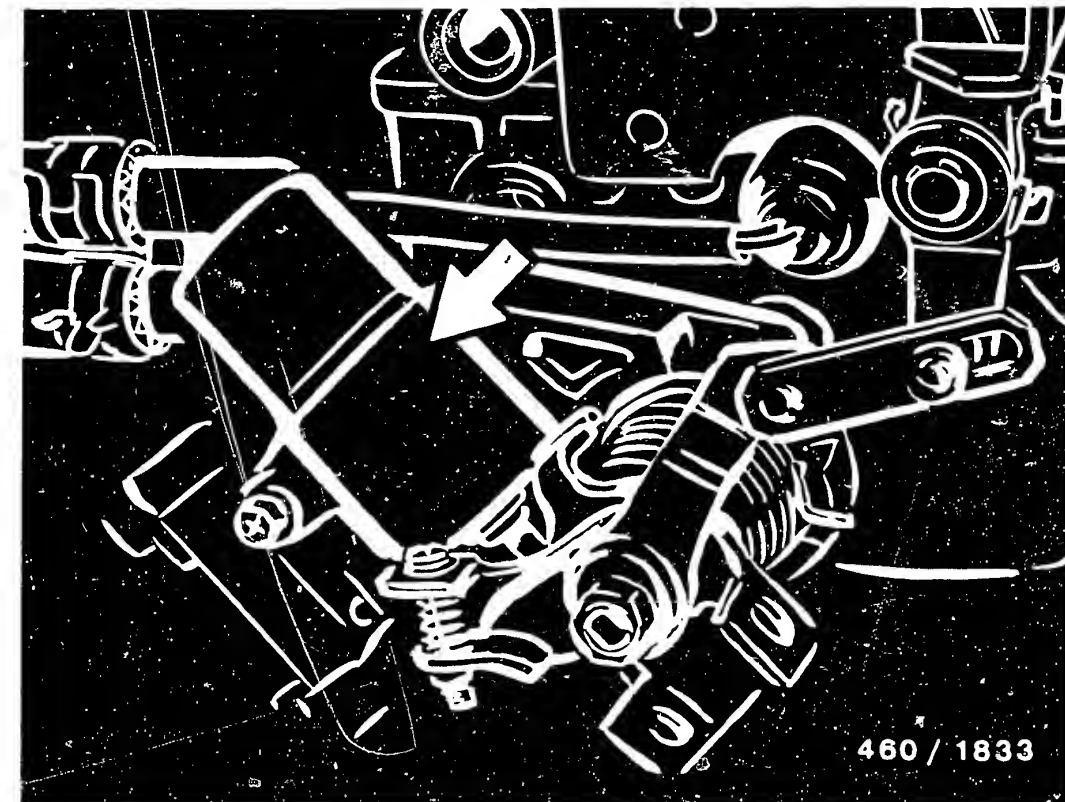
Loosen fuel-injection tubing using open-ring wrench.

Plug-in connection of shutoff solenoid.



Arrow = Ball socket

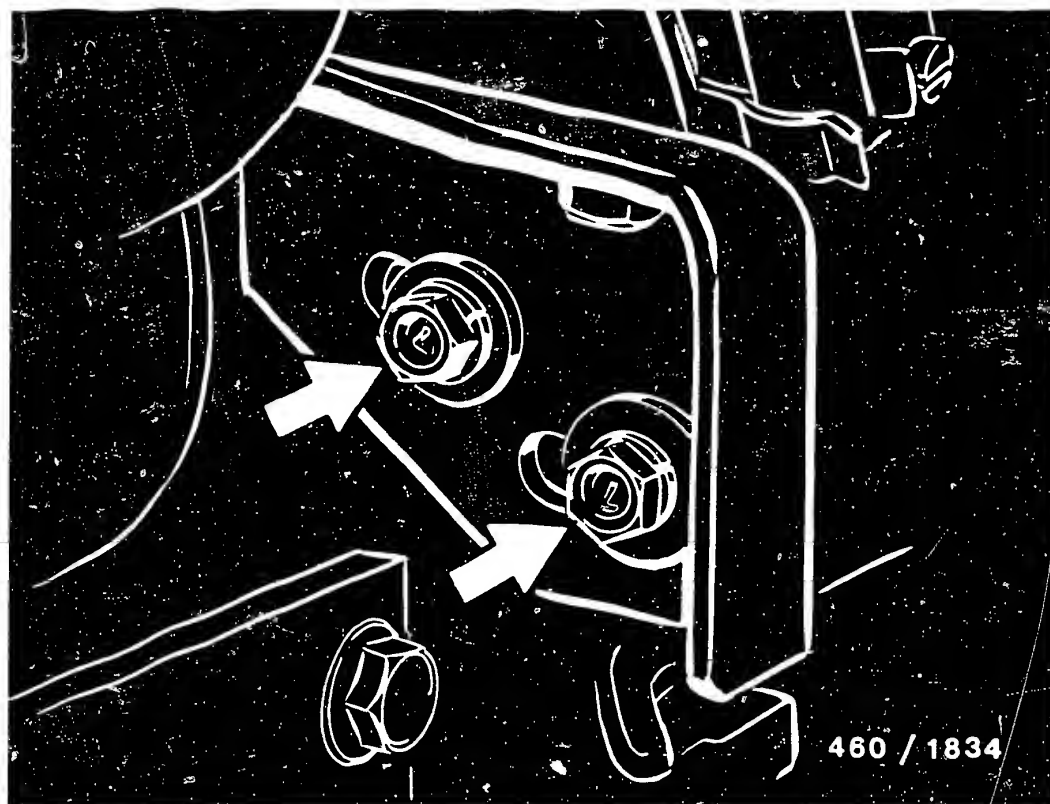
Remove latch from ball socket and push off ball socket.  
Unhook bowden cable from bracket.



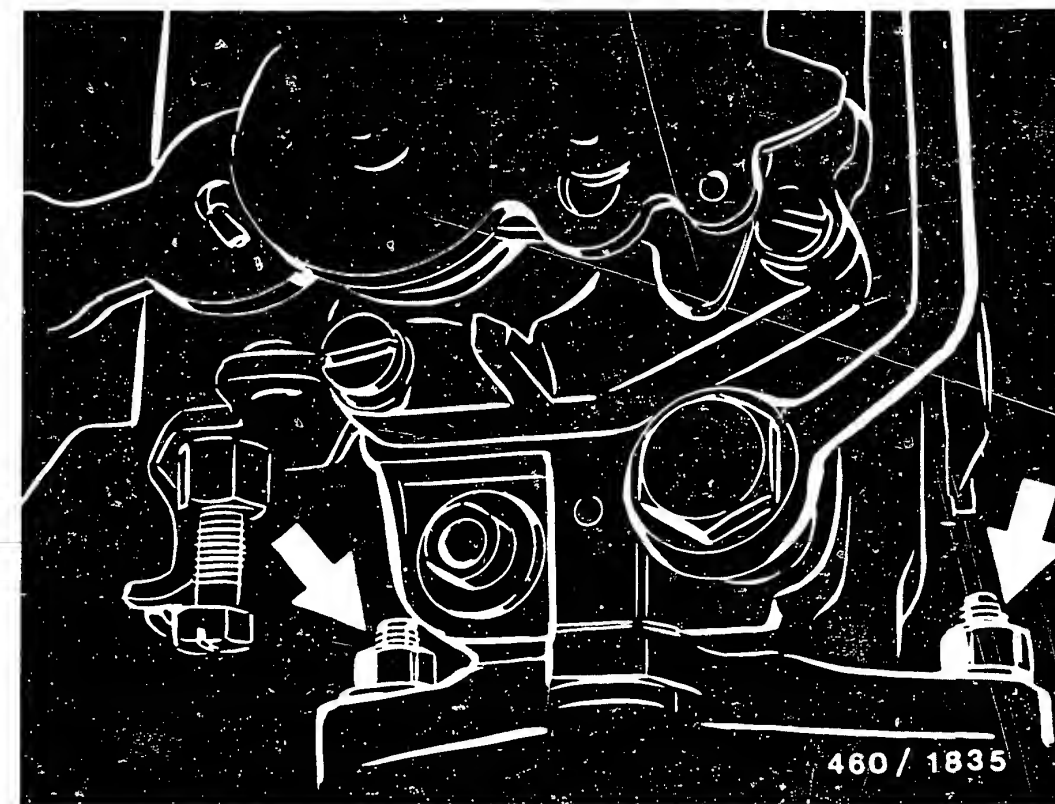
Arrow = Control device (KSB = Cold-start injection advance)

Using commercially available hose clampers, pinch off cooling-water hoses just after the control device (KSB) and remove.

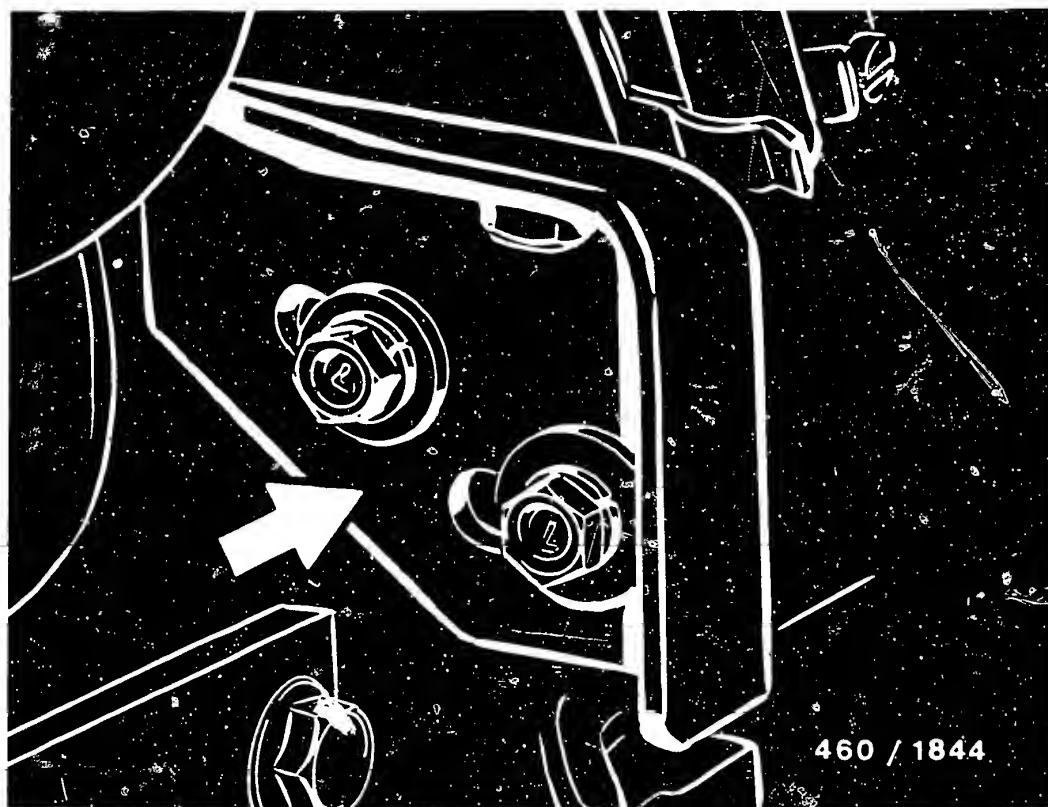




Unscrew fastening screws of the support bracket of the injection pump (arrows).



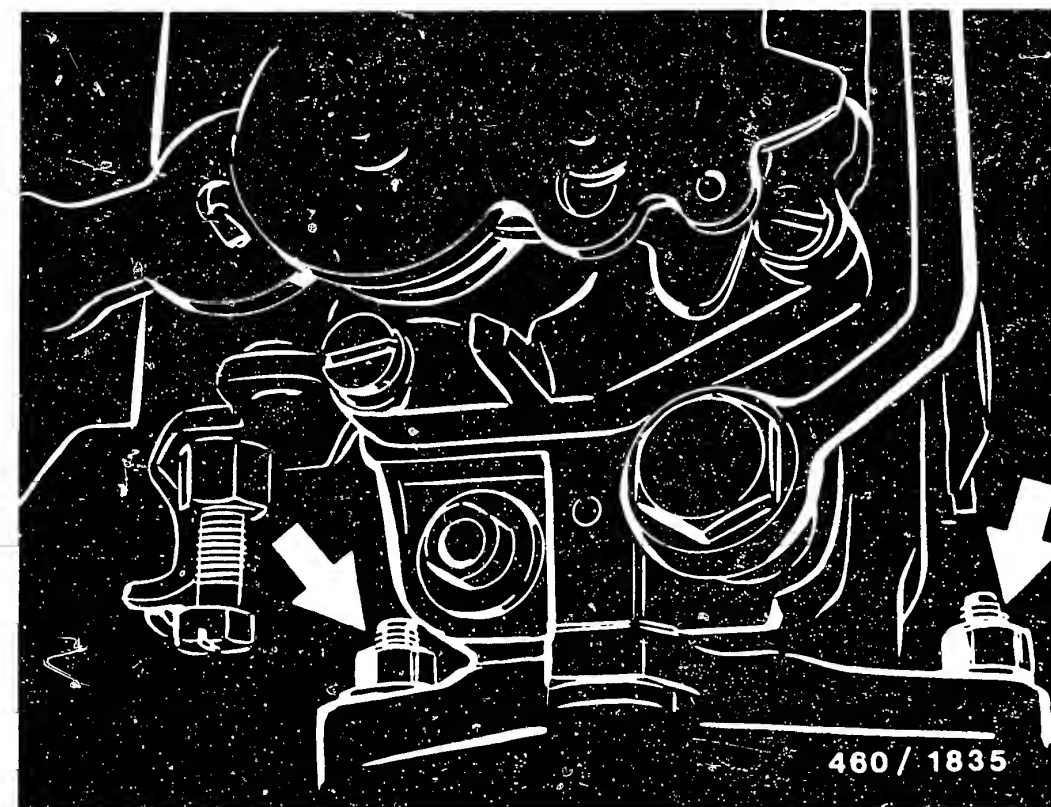
Remove fastening nuts (arrows) of the injection pump from the pump flange and remove injection pump.



Arrow = Support bracket

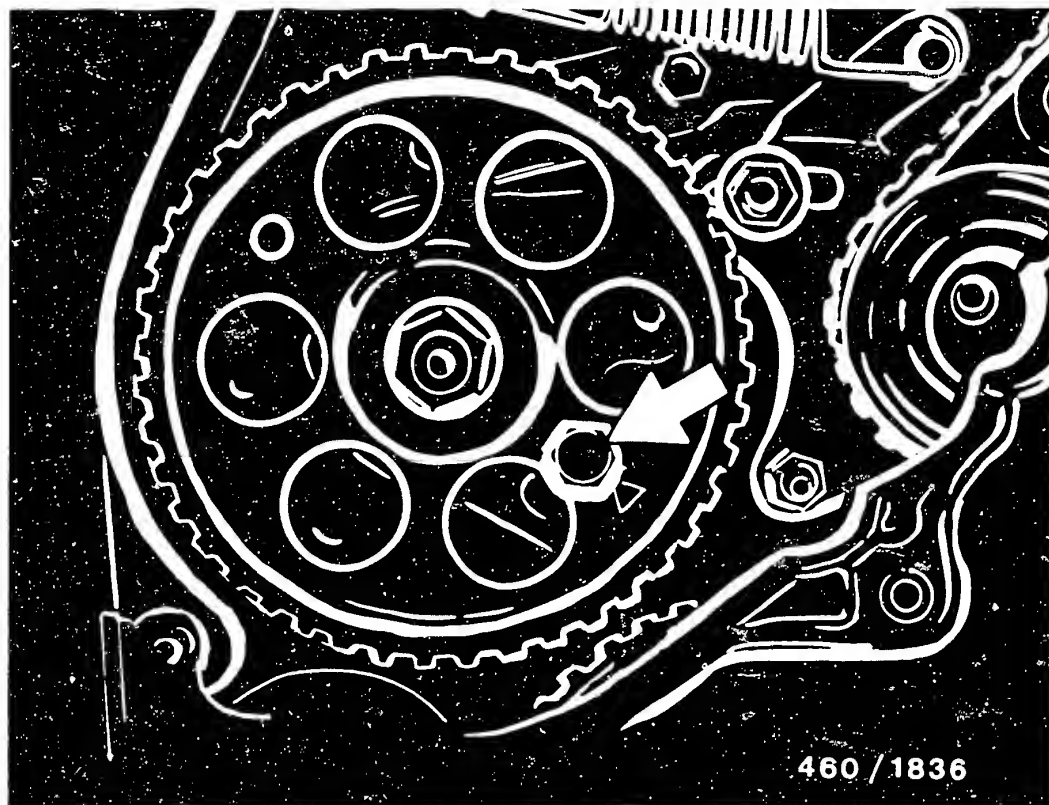
#### INSTALL FUEL-INJECTION PUMP

Mount support bracket on injection pump and tighten to 45 Nm.



Insert injection pump into pump flange and slightly tighten fastening nuts (arrows).



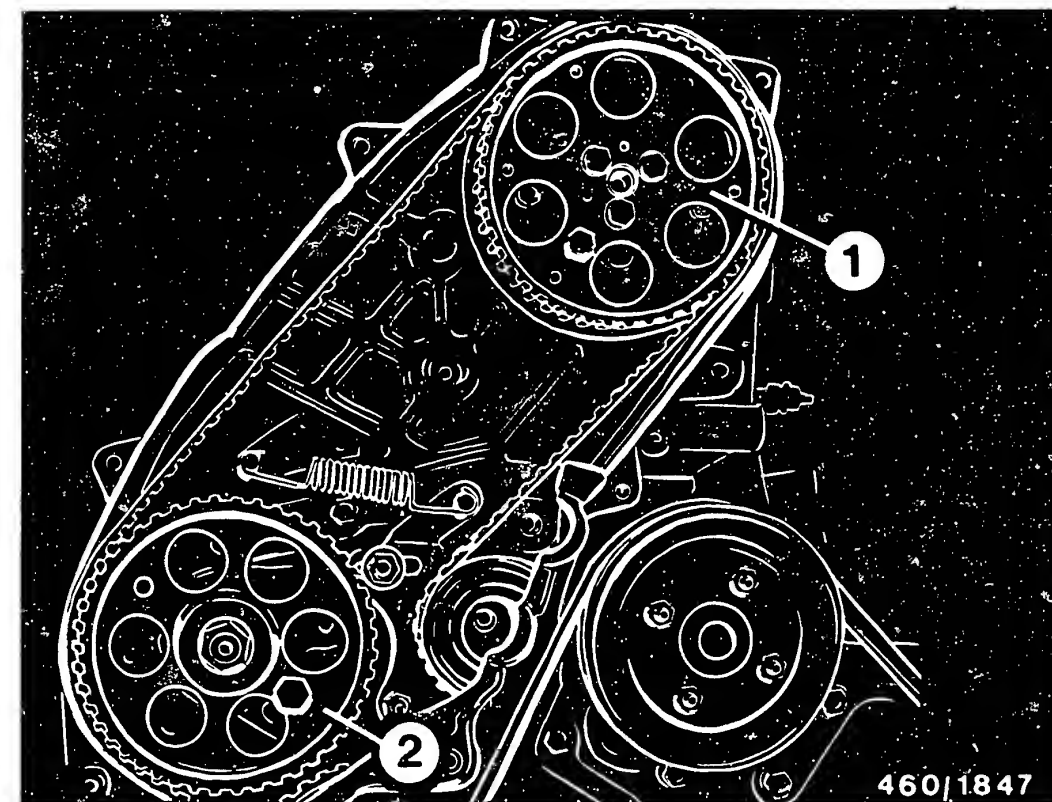


Arrow = TDC locking screw

Insert Woodruff key into groove of the injection-pump drive shaft.

Mount injection-pump gear and fix using TDC locking screw.

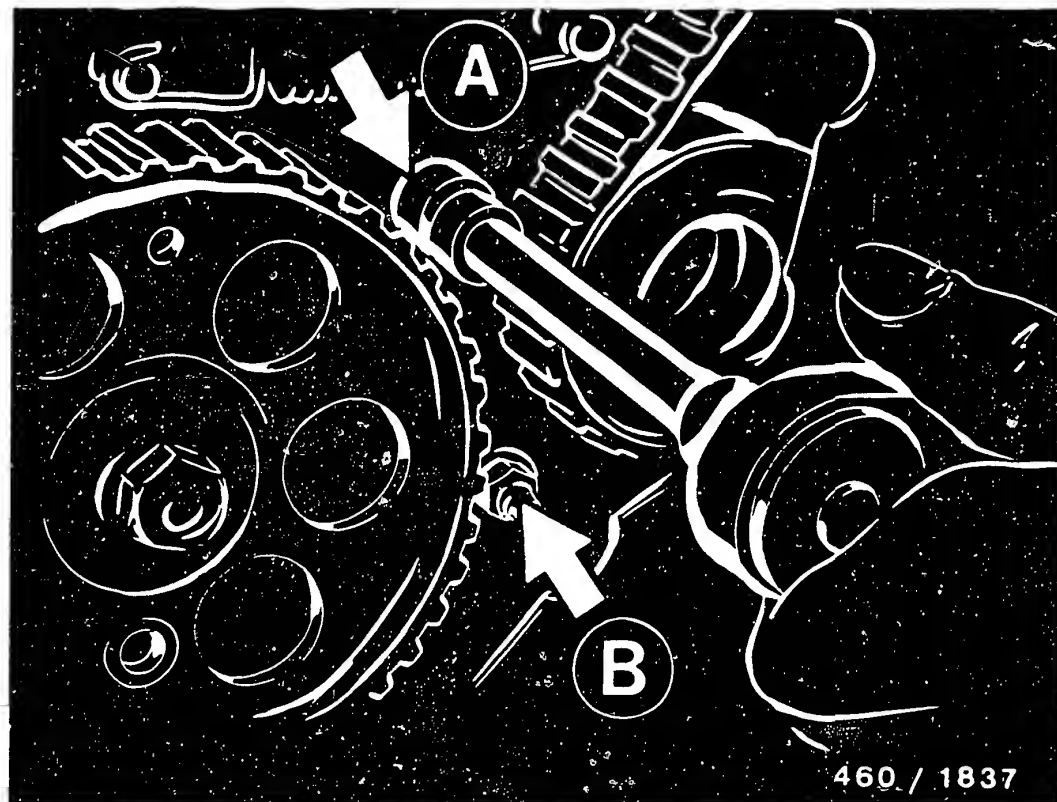
Tighten fastening nut to 70 Nm.



1 = Camshaft gear

2 = Injection-pump gear

Starting from the crankshaft gear, position the toothed belt into the tothing of the injection-pump gear and, exerting tension, continue positioning over the camshaft gear.

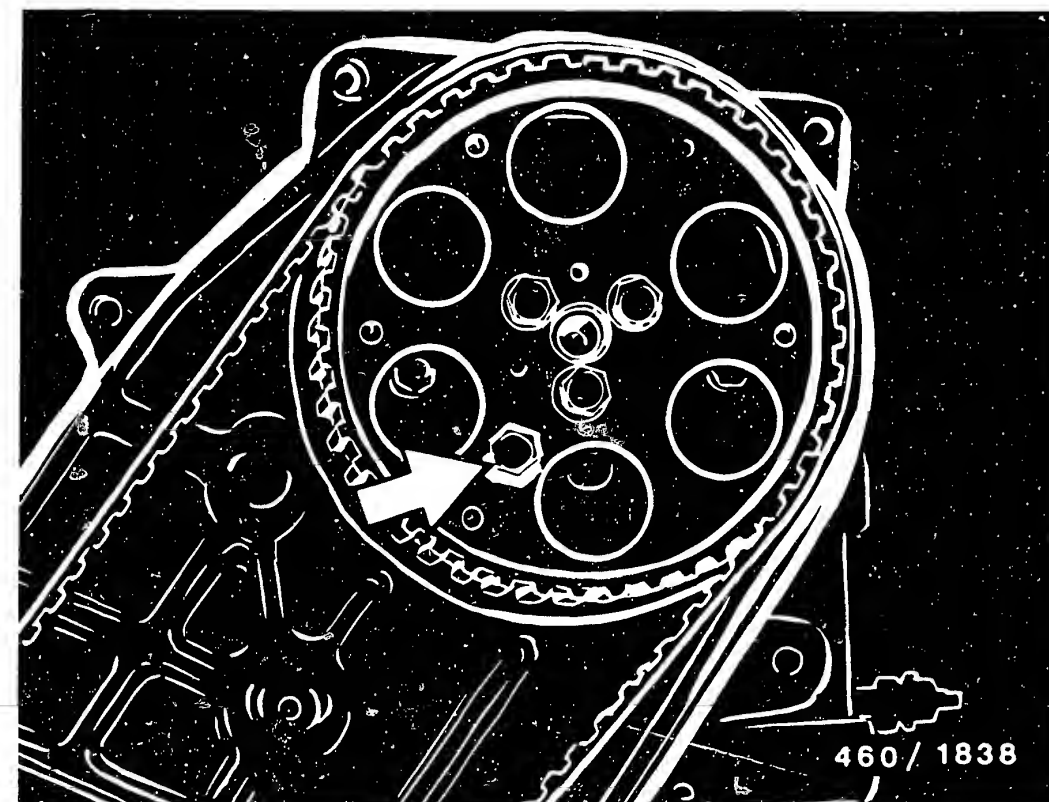


A = Tensioning-roller securing bolt  
B = Tensioning-roller fastening nut

Hook in Woodruff key.

Engine is positioned at TDC marking!

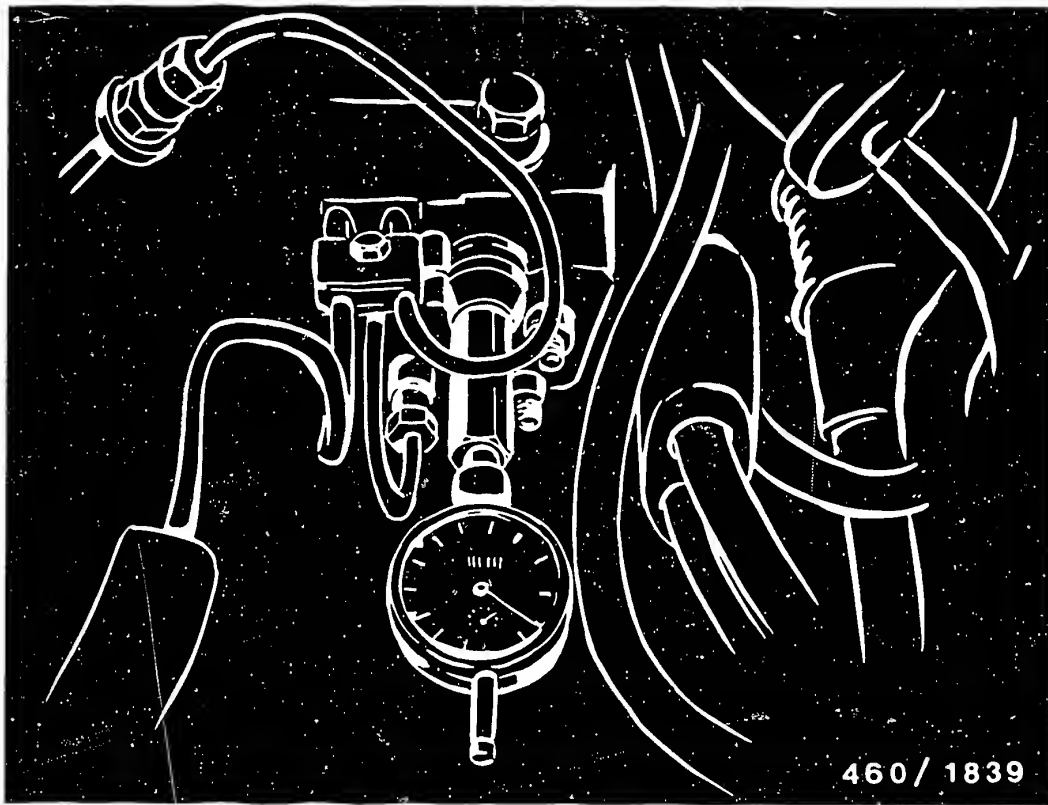
Tighten tensioning-roller securing bolt (A) to  
5 Nm.  
Tighten tensioning-roller fastening nut (B) to  
25 Nm.



Arrow = TDC locking screw

Remove TDC locking screws from camshaft  
gear.

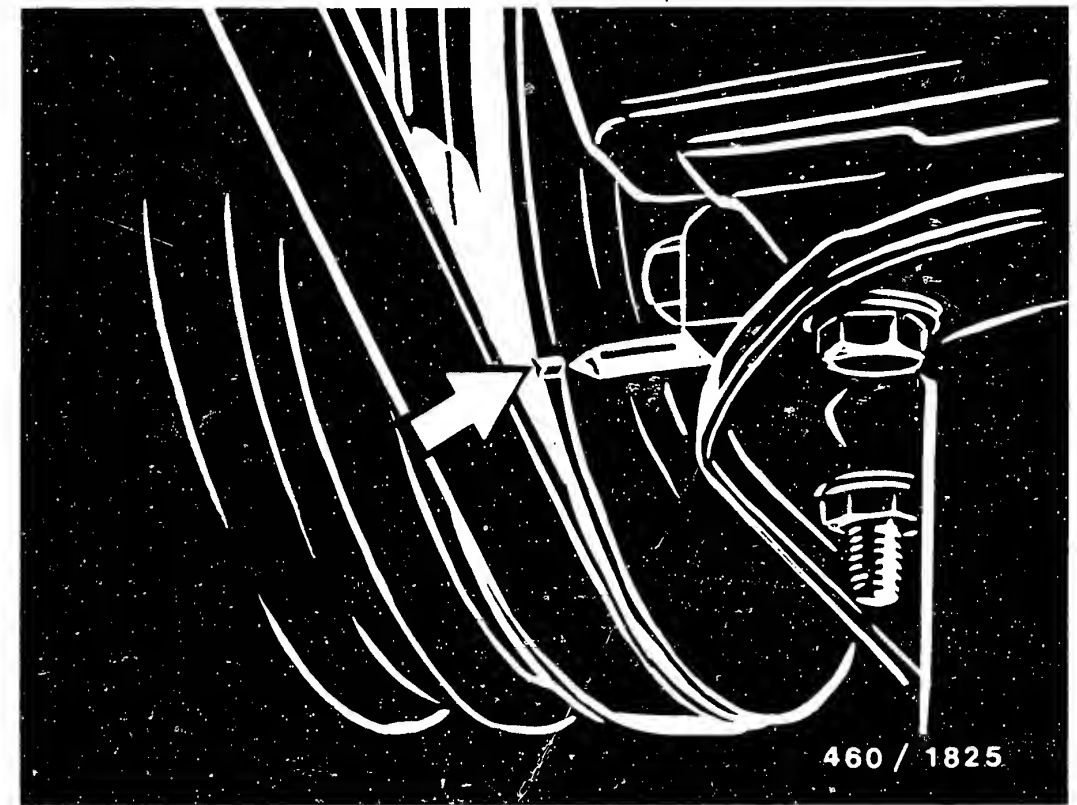
Mount toothed-belt guide plate on camshaft  
drive gear.



Unscrew bleeder screw from central screw plug (triangle-head bolt) of hydraulic head.

Screw measuring tool KDEP 1085 into the tapped hole of the bleeder screw.

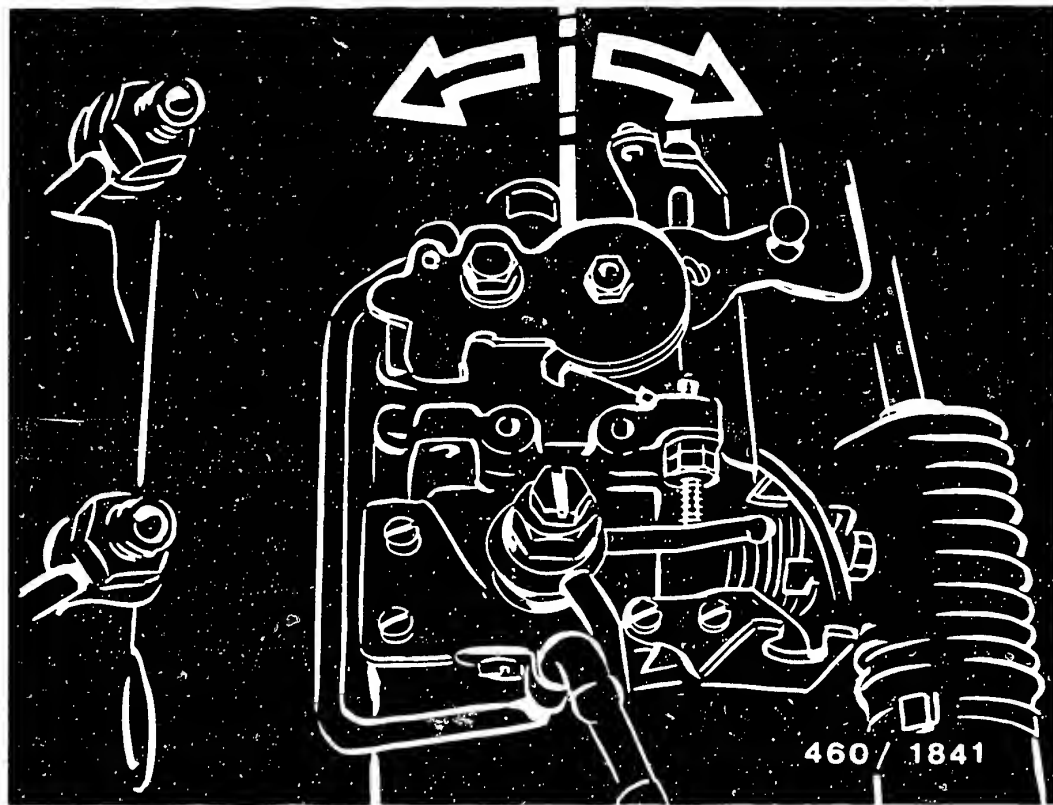
Insert dial indicator with measuring insert into measuring tool KDEP 1085.



Preload dial indicator by approx. 5.0 mm. Turn crankshaft slowly against the direction of engine rotation until the pointer of the dial indicator no longer moves. Preload dial indicator by approx. 1.0 mm and set to "0".

Turn crankshaft in the direction of engine rotation until the TDC marking on the crankshaft pulley aligns with the pointer on the engine block.

In this position, the dial indicator must indicate a stroke (for dimension, see brief instructions) after BDC.



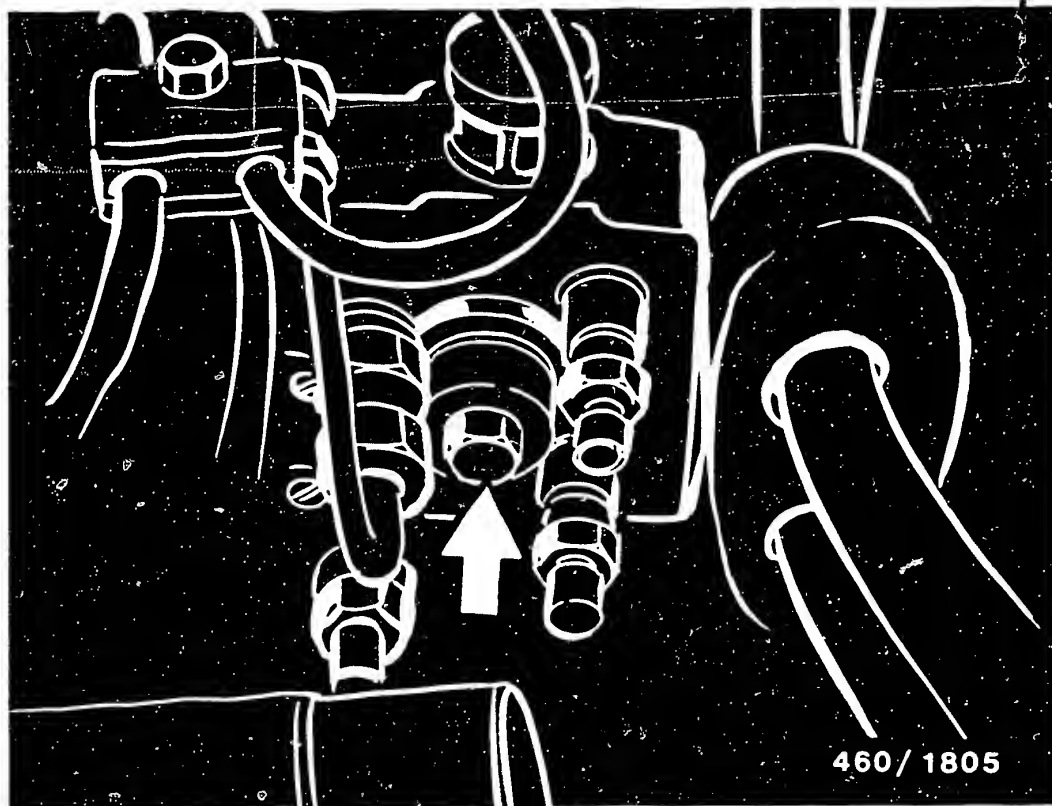
Tighten fastening nuts of injection pump (1) to 25 Nm.

Tighten fastening screws of support bracket (2) to 45 Nm.

If necessary, correct stroke by pivoting the injection pump.

Value too high: pivot pump toward engine.  
Value too low: pivot pump away from engine.

Turn over crankshaft twice and check adjustment.

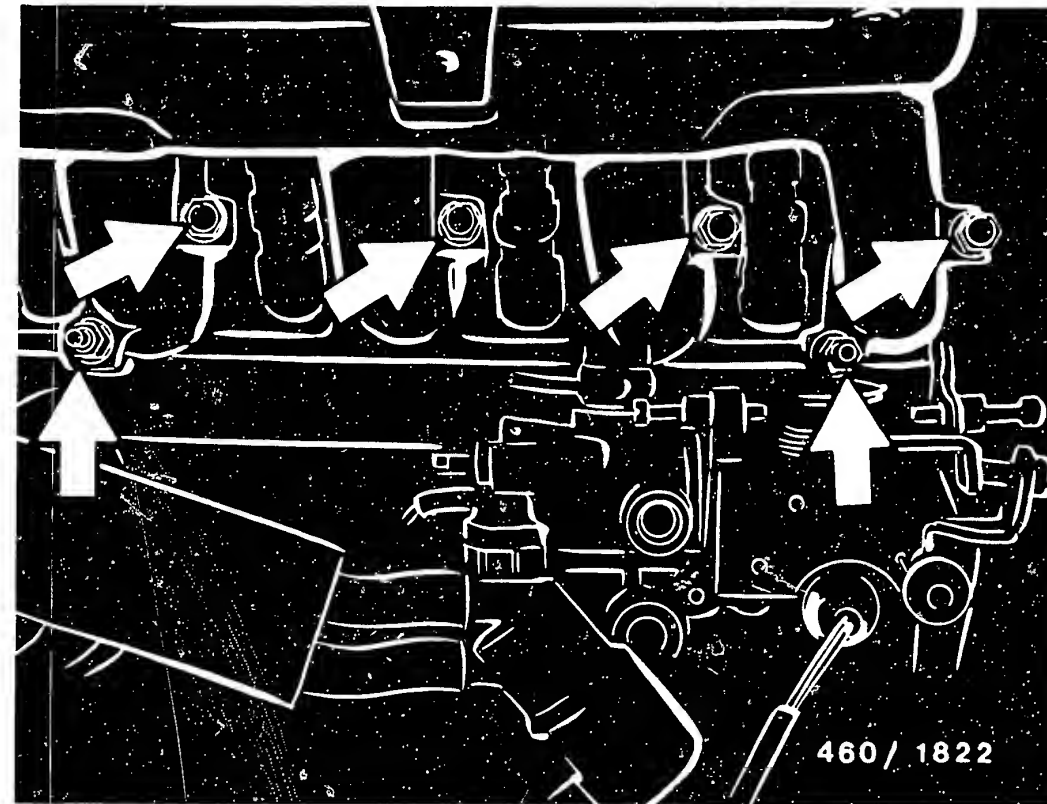


Remove measuring tool KDEP 1085 with dial indicator.

Screw bleeder screw (arrow) with new gasket into central screw plug.

Tighten fuel-injection tubing using open-ring wrench KDEP 1115, while preventing the delivery-valve holders from turning (out of adjustment) by counterholding.

Mount oil filter.



Mount fuel-inlet line and fuel-return line.

Bolt on air-filter housing with intake manifold and new gasket to 25 Nm (arrows).

Mount crankcase breather, vacuum hose and fuel filter.

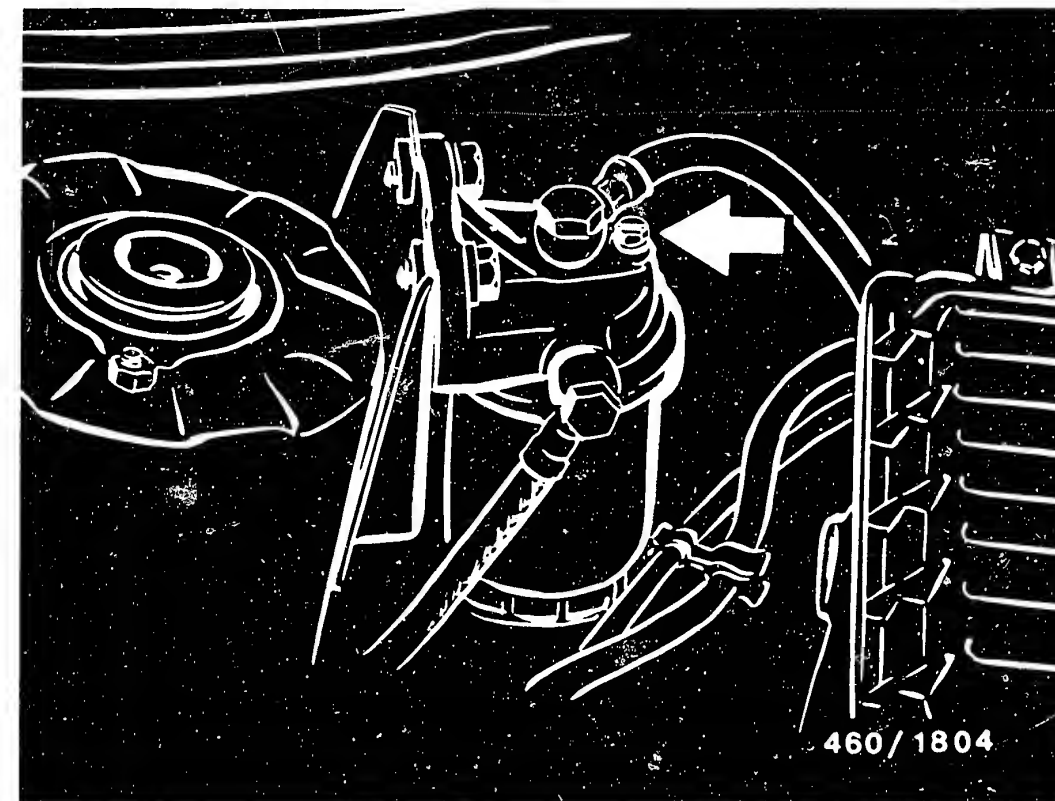
Connect up plug-in connection of shutoff solenoid and push into bracket on injection pump.

Connect lead of series resistor.

Mount air-intake hose.

Push off ball socket and secure. Mount bowden cable.

Connect negative terminal to battery.

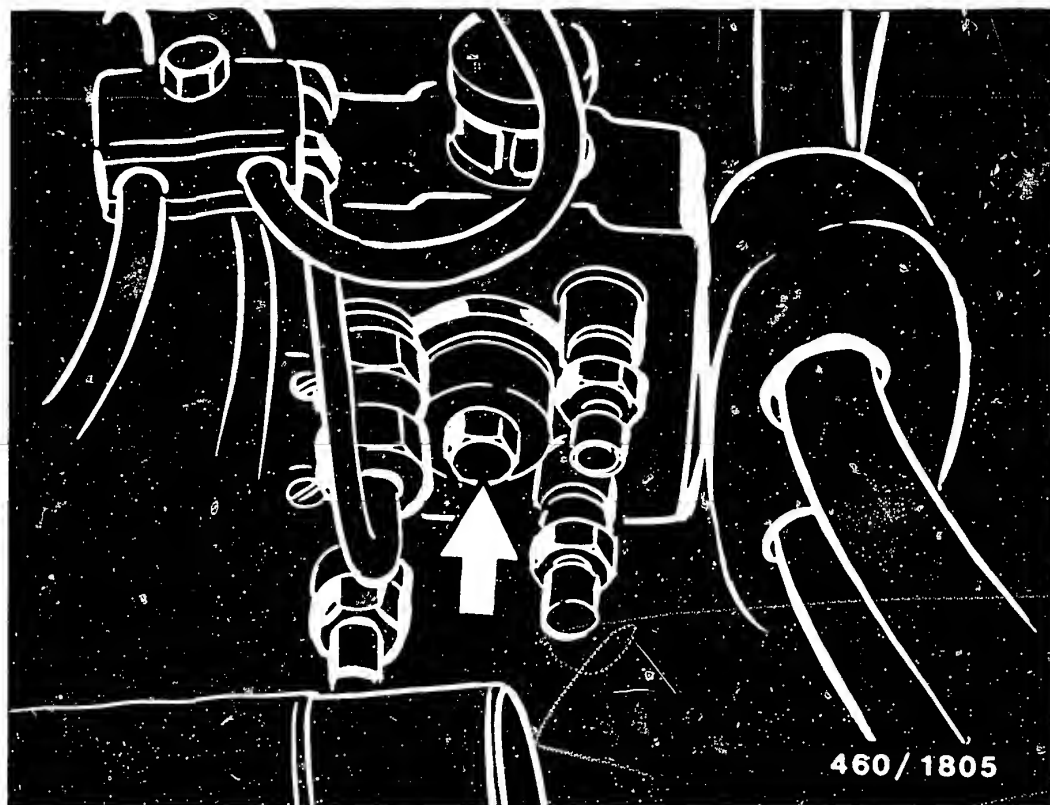


Arrow = Bleeder screw

#### BLEED FUEL SYSTEM

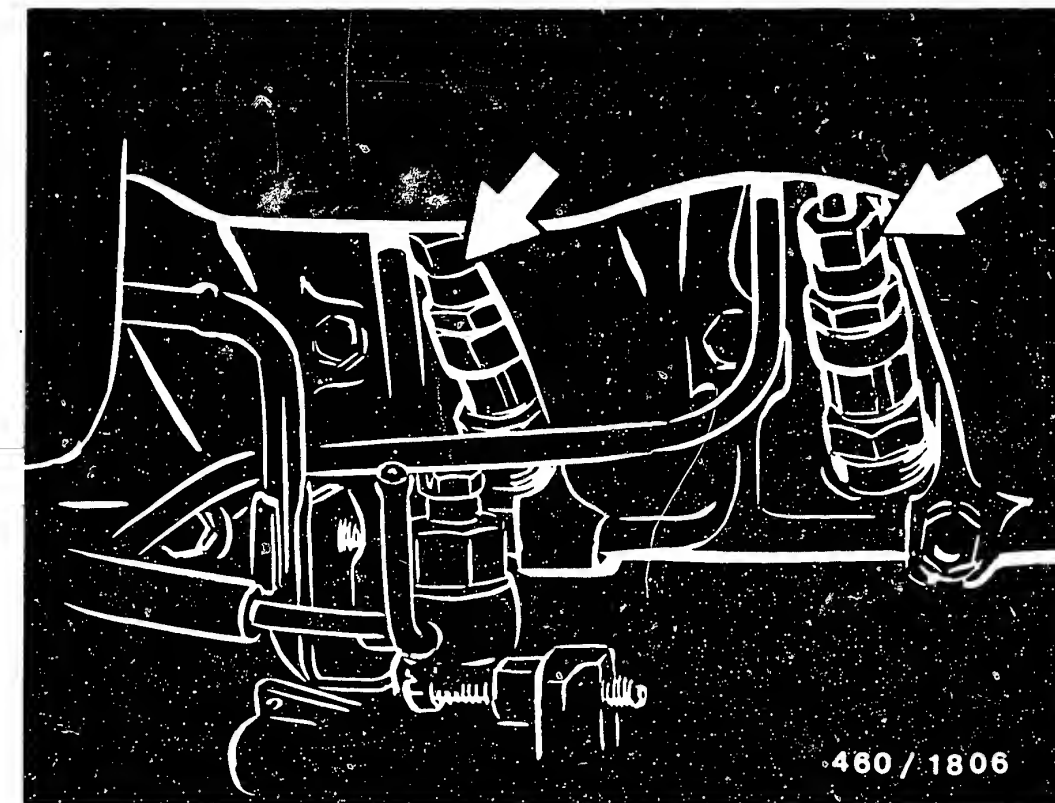
Fill up the fuel filter and injection pump with diesel fuel.

Seal off bleeder screw on fuel filter.



Arrow = Bleeder screw, pump

Operate starting motor without preheating until fuel escapes.  
Tighten bleeder screw.



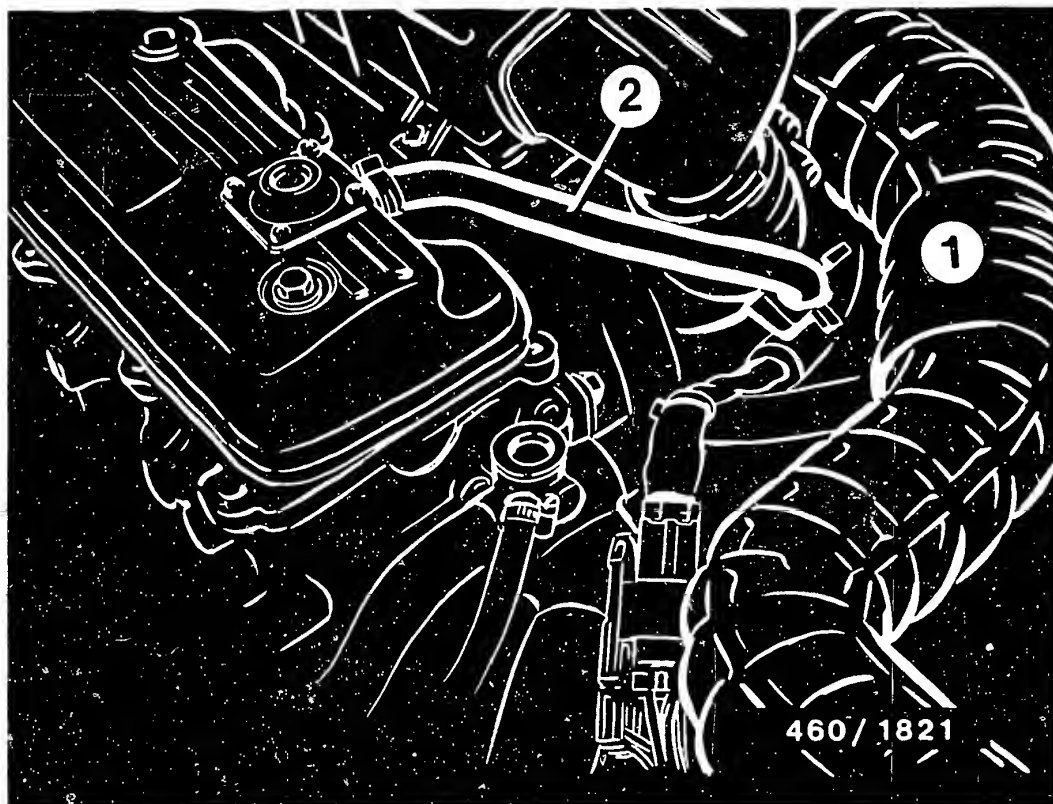
Loosen union nuts of fuel-injection tubing at the injection-nozzle-holder assemblies (arrows).

Operate starting motor without preheating until fuel escapes from union nuts of the injection-nozzle-holder assemblies.

Tighten union nuts.

Operate starting motor until engine starts.



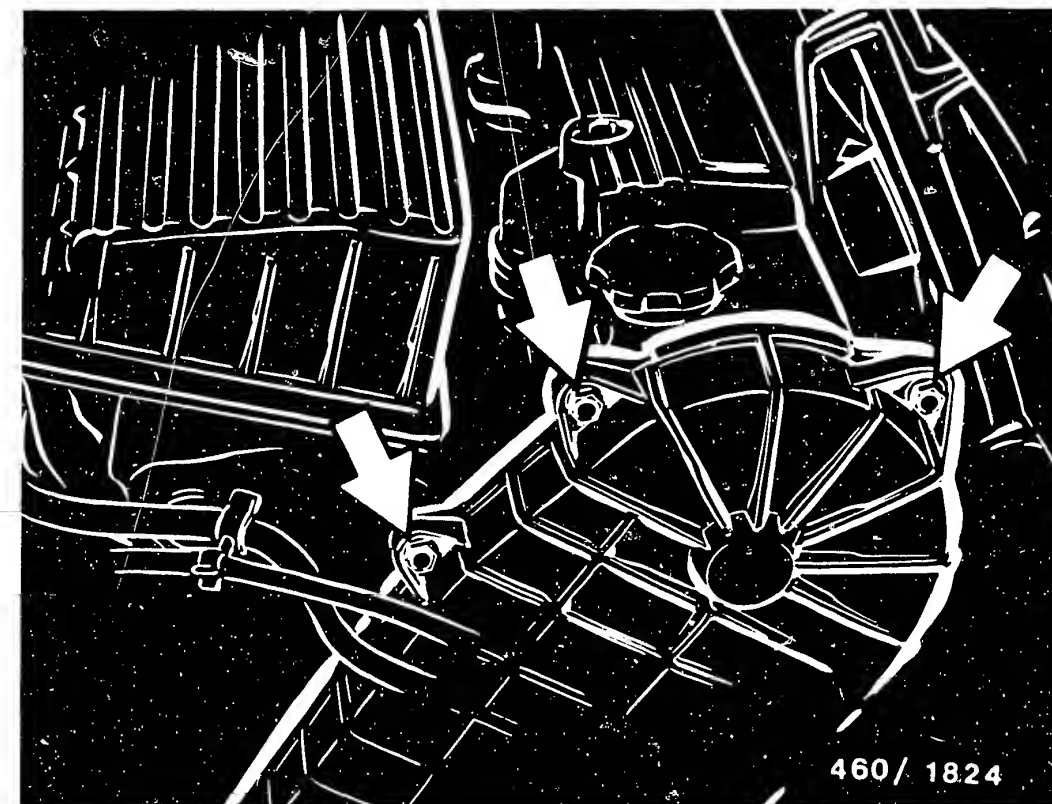


1 = Air-intake hose, air filter  
2 = Hose, crankcase breather

#### TEST AND ADJUST ENGINE TIMING

##### Test engine timing

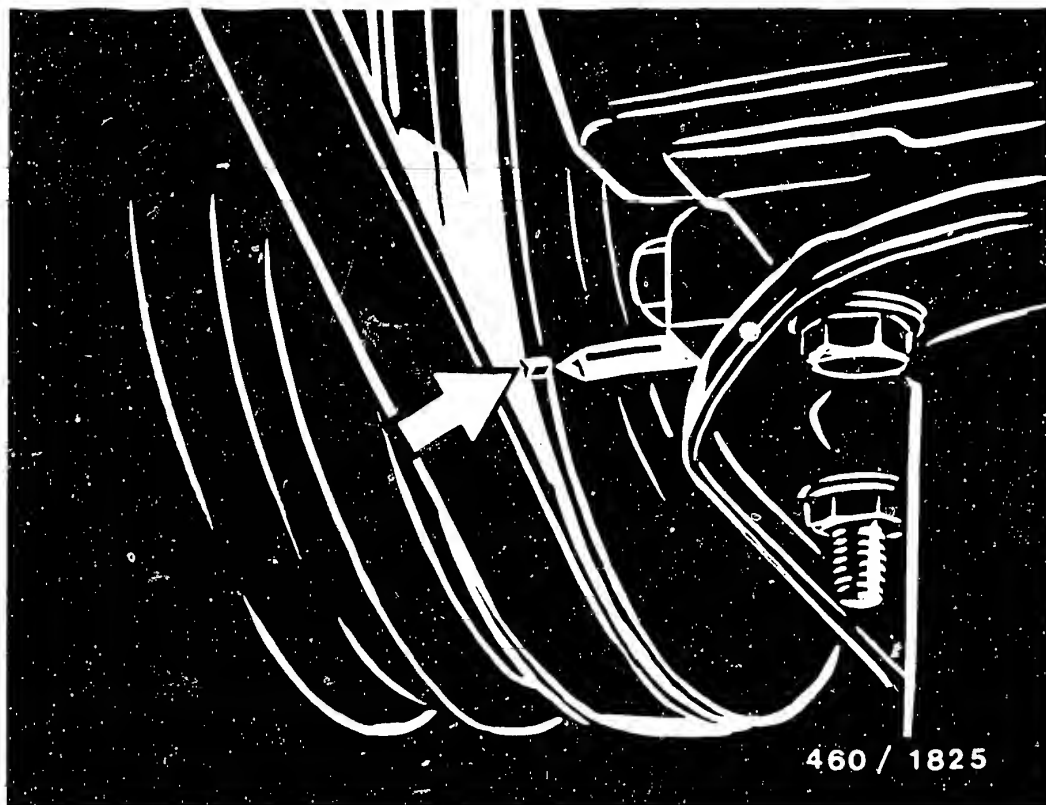
Disconnect negative cable from battery.  
Remove air-intake hose from air filter.  
Remove crankcase breather and unscrew  
vacuum hose from air filter.



Remove cooling-water hoses from the upper  
toothed-belt cover.

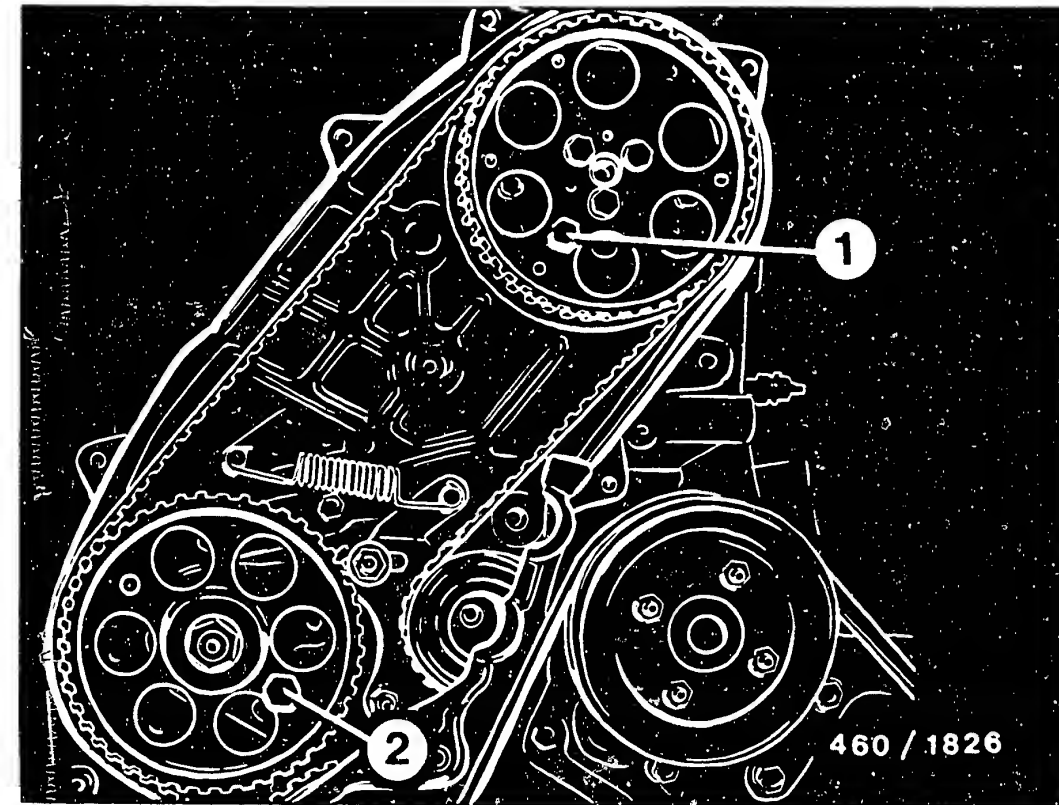
Remove upper toothed-belt cover (arrows).





Turn crankshaft in the direction of engine rotation until the marking of the crankshaft pulley aligns with the pointer on the engine block.

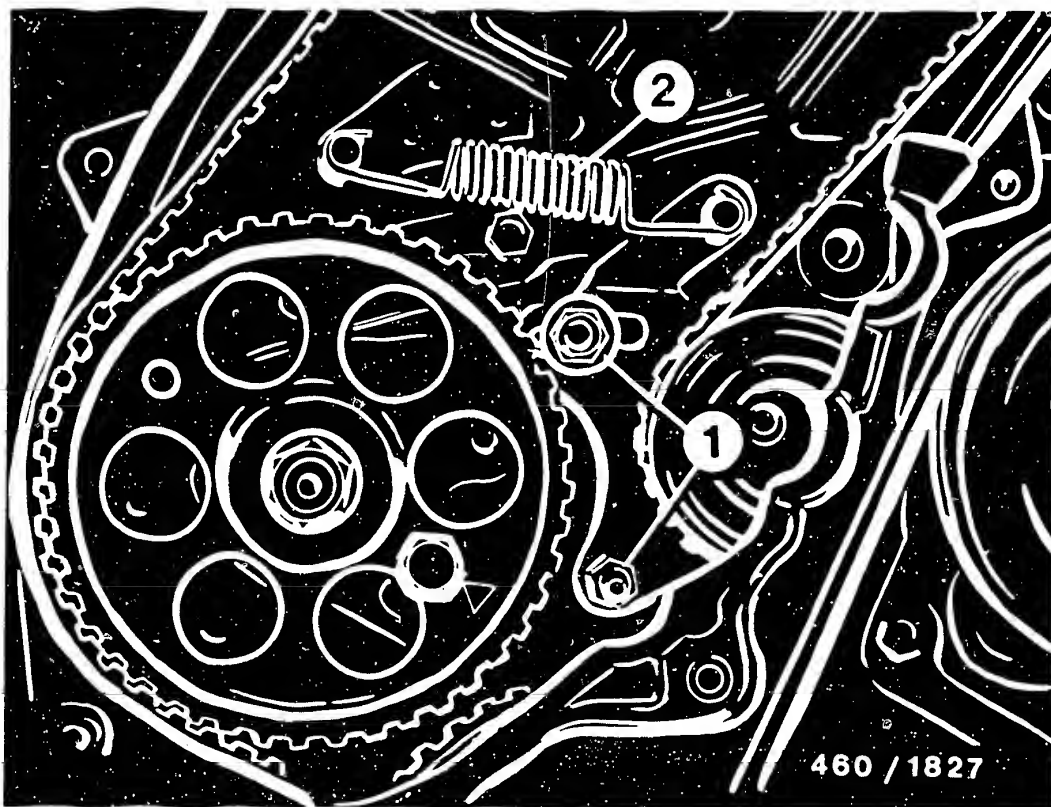
The piston of cylinder 1 is at TDC, the valves of cylinder 4 are on overlap.



- 1 = TDC locking screw of camshaft gear, M6 thread
- 2 = TDC locking screw of injection-pump gear, M8 thread

In this position, screw TDC locking screws into camshaft gear and injection-pump gear.

If the TDC locking screws cannot be installed, the engine timing must be corrected.



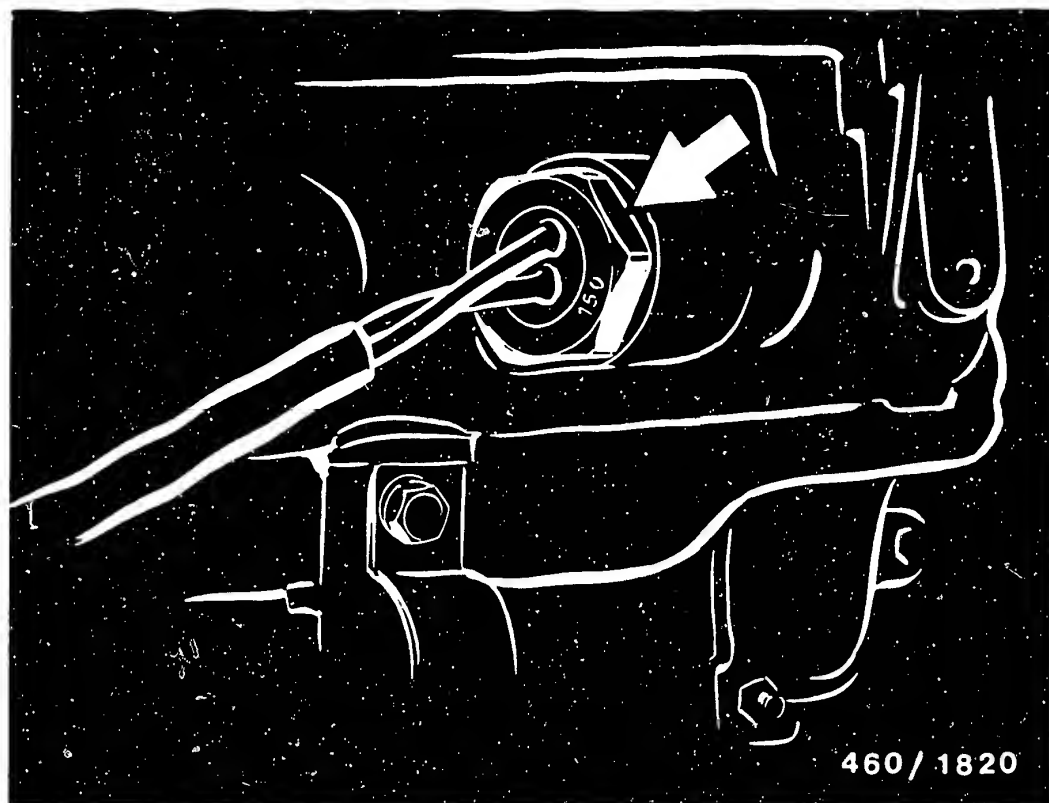
- 1 = Tensioning-roller mounting bolt and nut  
 2 = Extension spring

#### ADJUST ENGINE TIMING

Loosen tensioning-roller mounting bolt and nut and unhook extension spring.

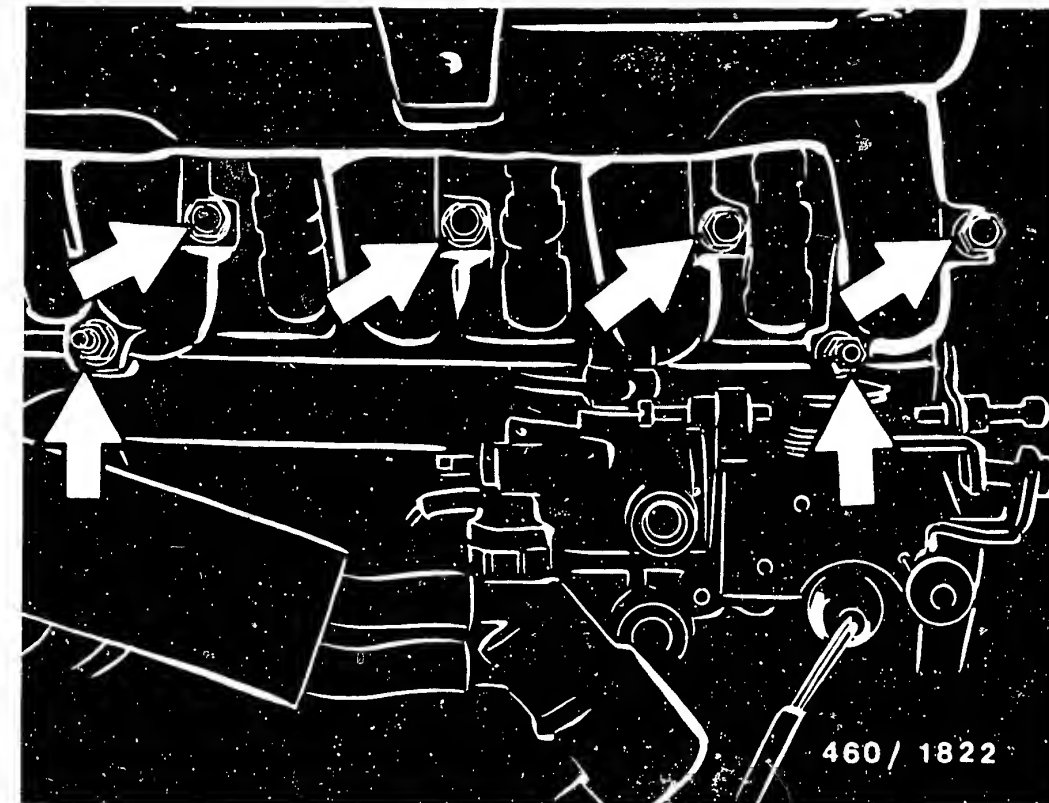


Unscrew toothed-belt guide plate from camshaft drive gear (arrows) and remove toothed belt.



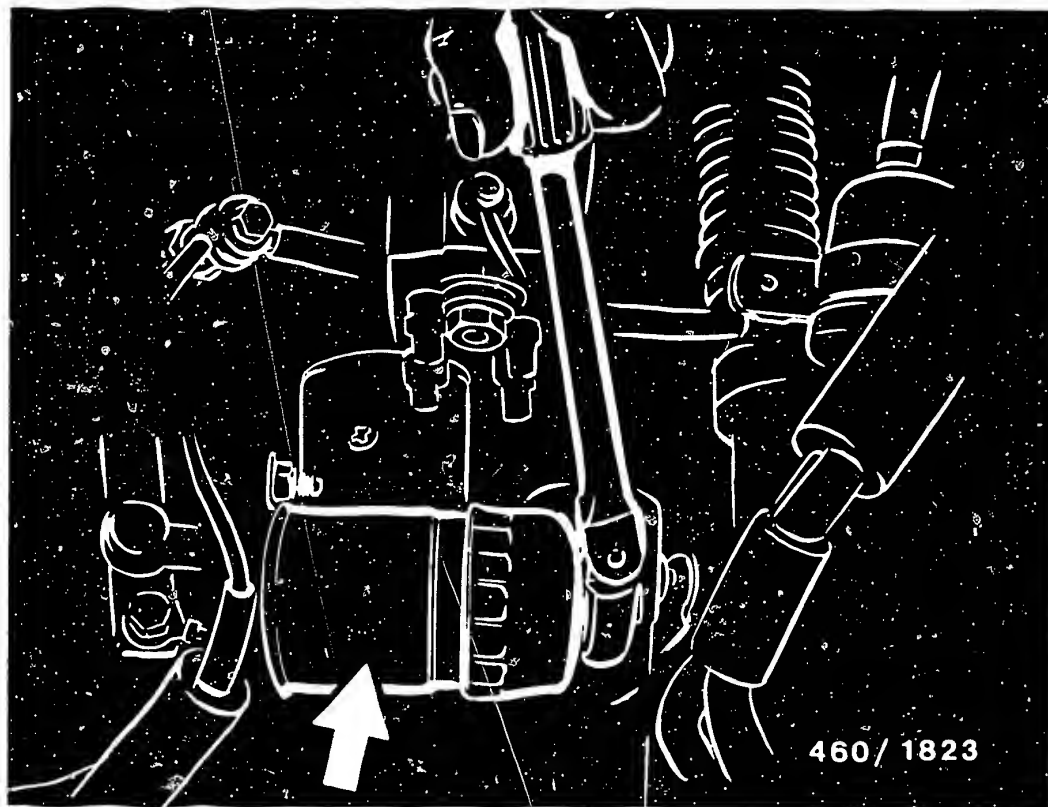
Arrow = Series resistor

Disconnect lead to series resistor.  
Unscrew fuel filter.



Remove fastening bolts of intake manifold  
(arrows).

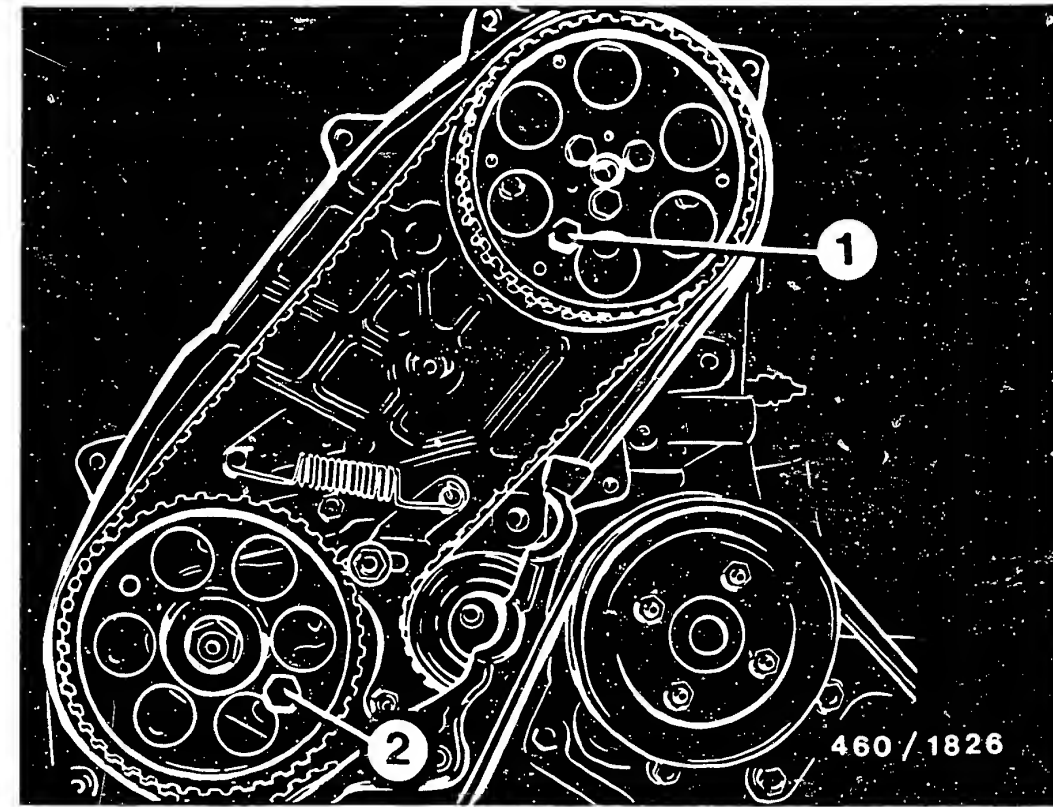
Remove intake manifold with air-filter  
housing.



Arrow = Oil filter

Unscrew oil filter using commercially available tool.

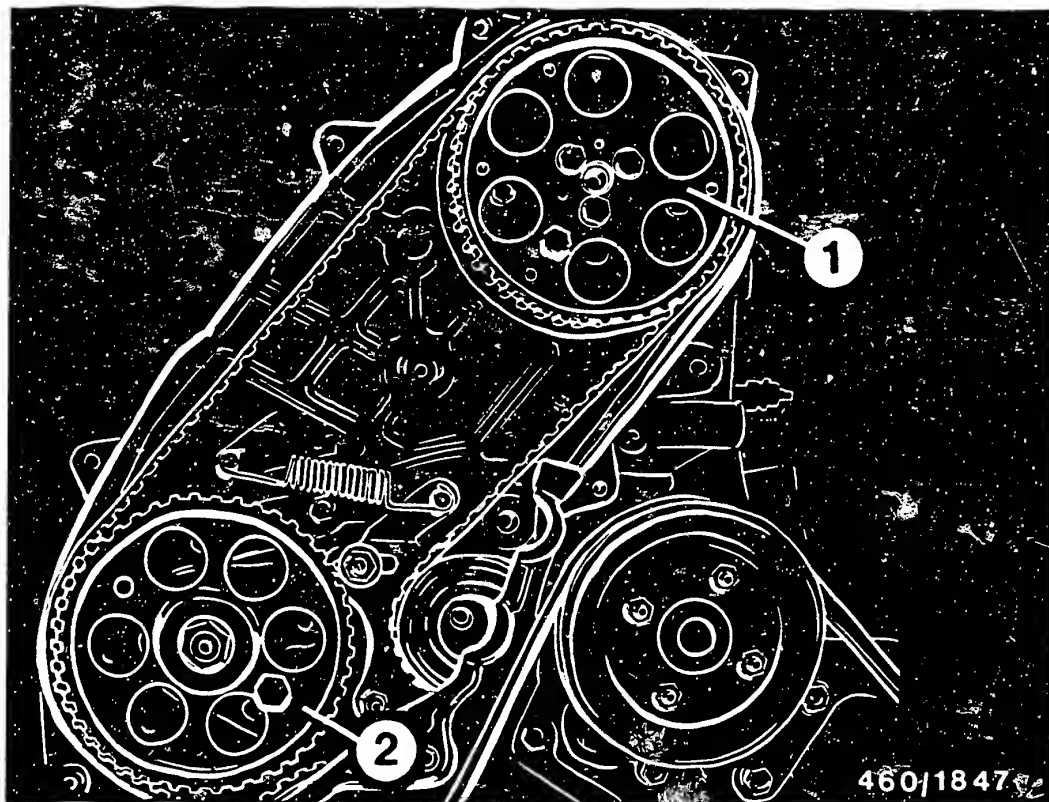
Unscrew vacuum-line bracket and alternator connecting cable.



1 = TDC locking screw of camshaft gear,  
M6 thread

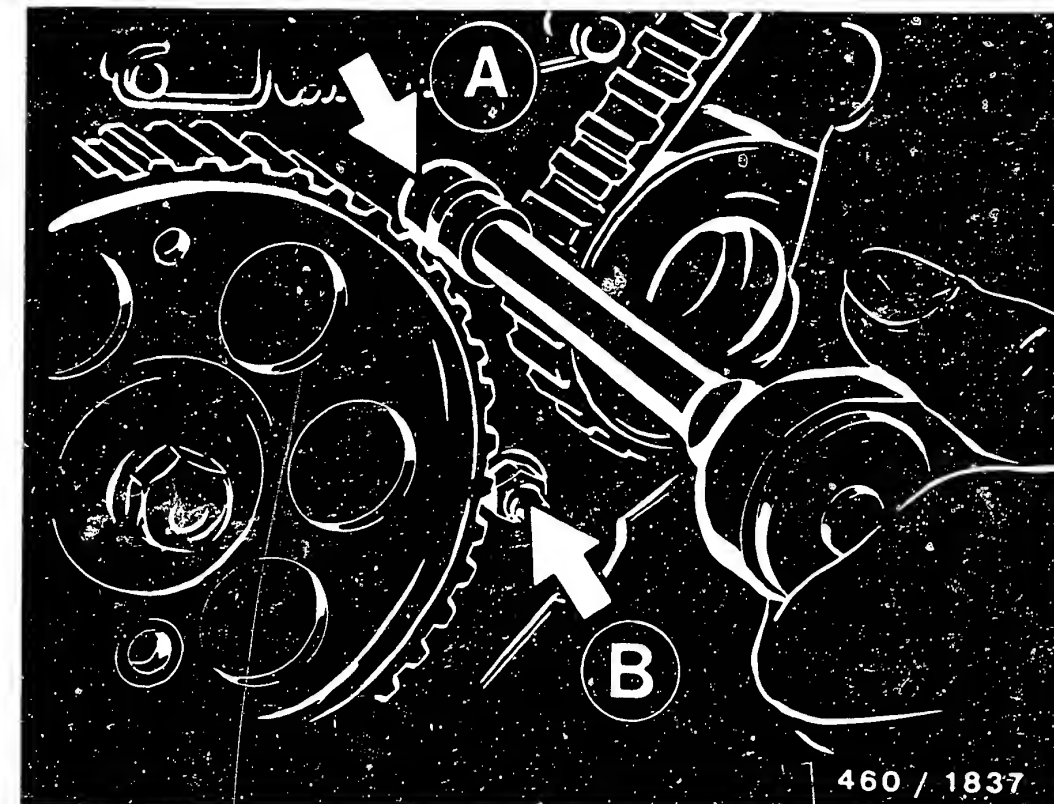
2 = TDC locking screw of injection-pump gear,  
M8 thread

Turn camshaft gear and injection-pump gear  
until TDC locking screws can be installed.



- 1 = Camshaft gear
- 2 = Injection-pump gear

Starting from the crankshaft gear, position the toothed belt into the tothing of the injection-pump gear and, exerting tension, continue positioning over the camshaft gear.

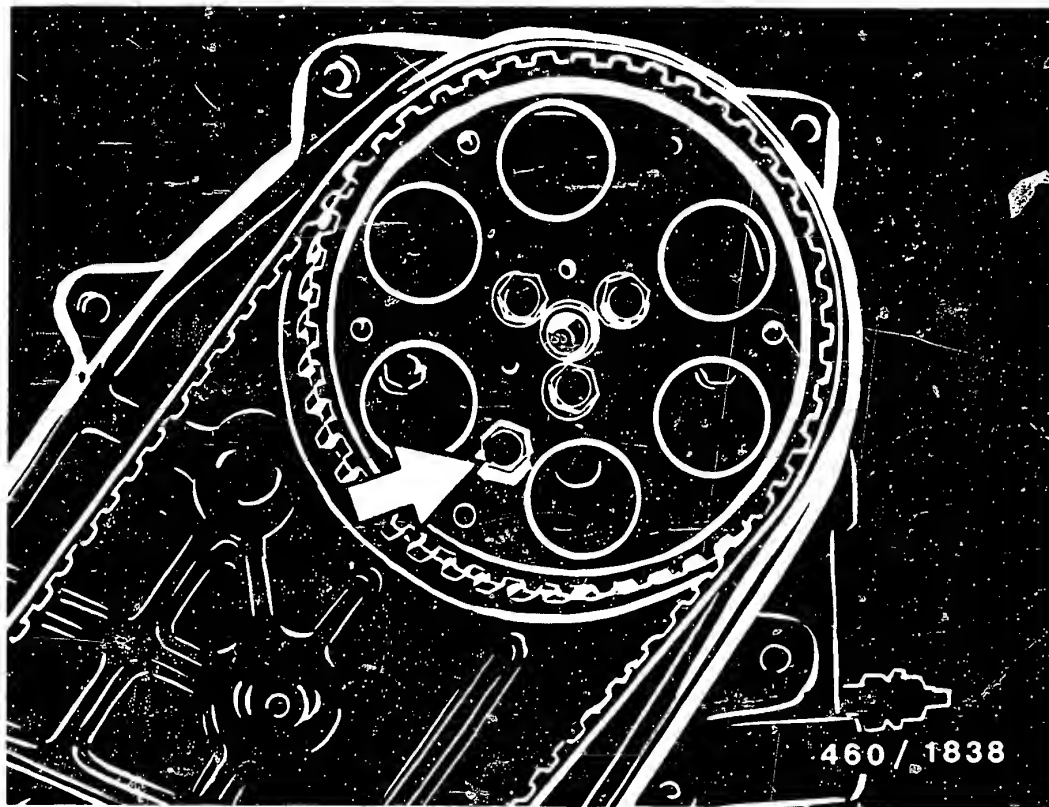


- A = Tensioning-roller securing bolt
- B = Tensioning-roller fastening nut

Hook in Woodruff key.

Engine is positioned at TDC marking!

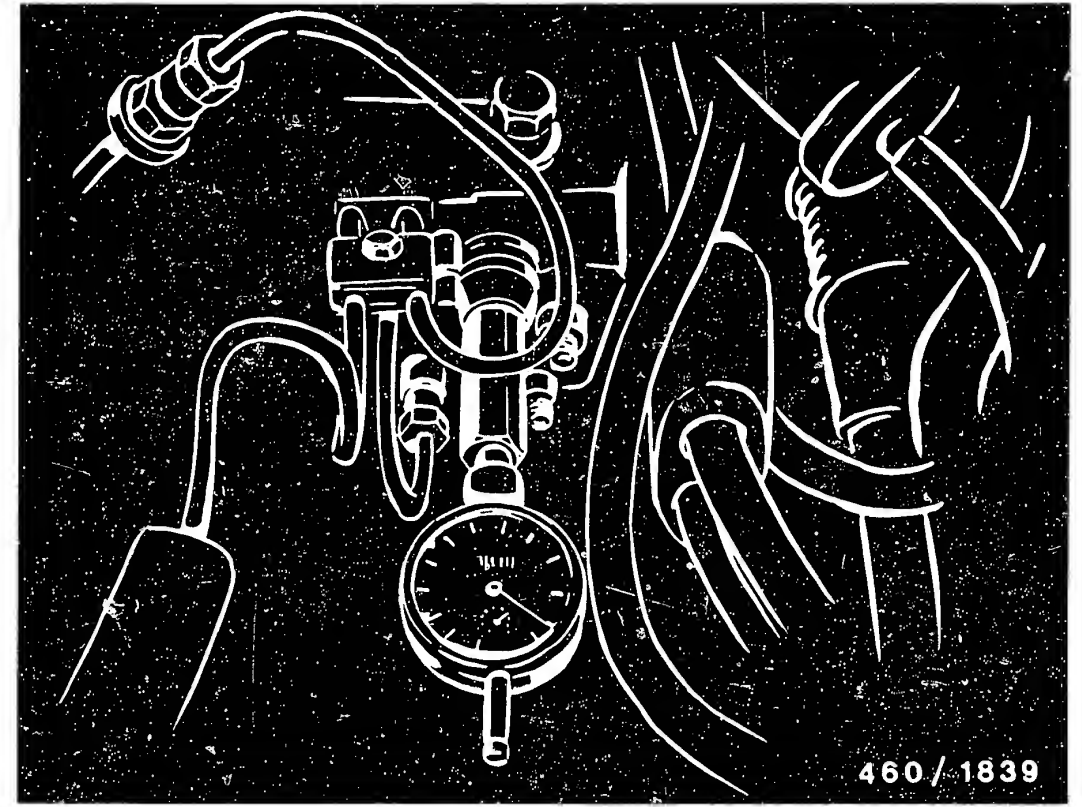
Tighten tensioning-roller securing bolt (A) to 5 Nm.  
Tighten tensioning-roller fastening nut (B) to 25 Nm.



Arrow = TDC locking screw

Remove TDC locking screws from camshaft gear.

Mount toothed-belt guide plate at camshaft drive gear.



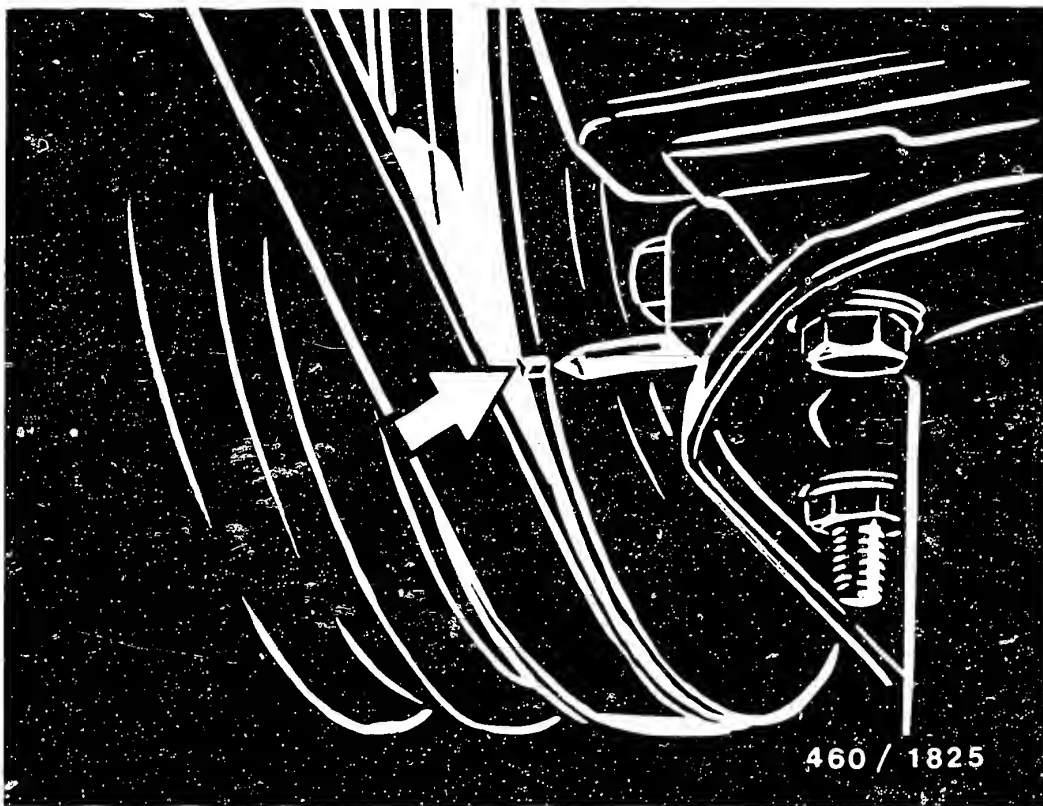
Remove fuel-injection tubing.

Screw bleeder screw out of central screw plug (triangle-head bolt) of the hydraulic head.

Mount measuring tool KDEP 1085 into the tapped hole of the bleeder screw.

Insert dial indicator with measuring insert into measuring tool KDEP 1085.





460 / 1825

Preload dial indicator by approx. 5.0 mm.  
Turn crankshaft slowly against the direction  
of engine rotation until the pointer of the dial  
indicator no longer moves.  
Preload dial indicator by approx. 1.0 mm and set  
to "0".

Turn crankshaft in the direction of engine  
rotation until the TDC marking on the crankshaft  
pulley aligns with the pointer on the engine  
block.

In this position, the dial indicator must indicate  
a stroke (for dimension, see brief instructions)  
after BDC.

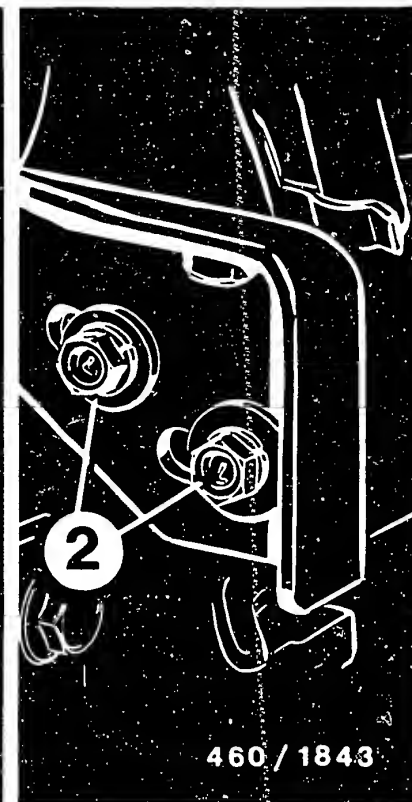
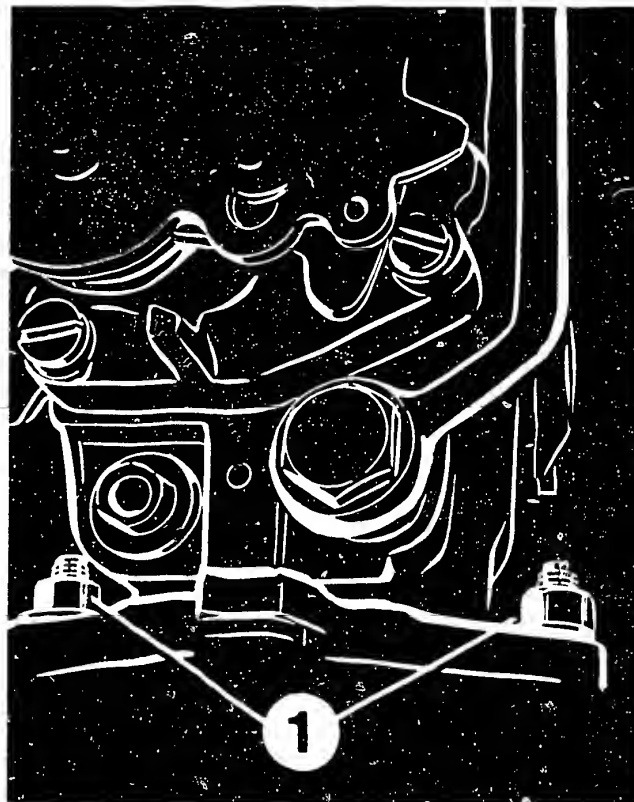


460 / 1841

If necessary, correct stroke by pivoting the  
injection pump.

Value too high: pivot pump toward engine.  
Value too low: pivot pump away from engine.

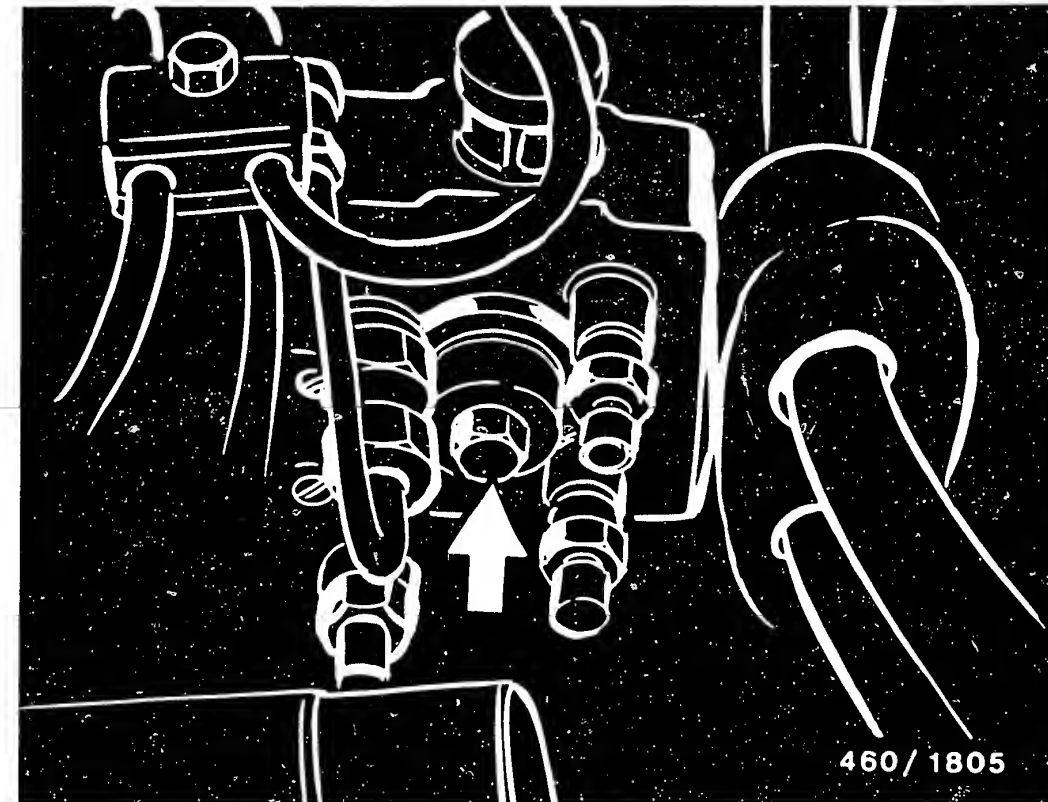
Turn over crankshaft twice and check adjustment.



460/1843

Tighten fastening nuts of injection pump (1) to 25 Nm.

Tighten fastening screws of support bracket (2) to 45 Nm.



460/1805

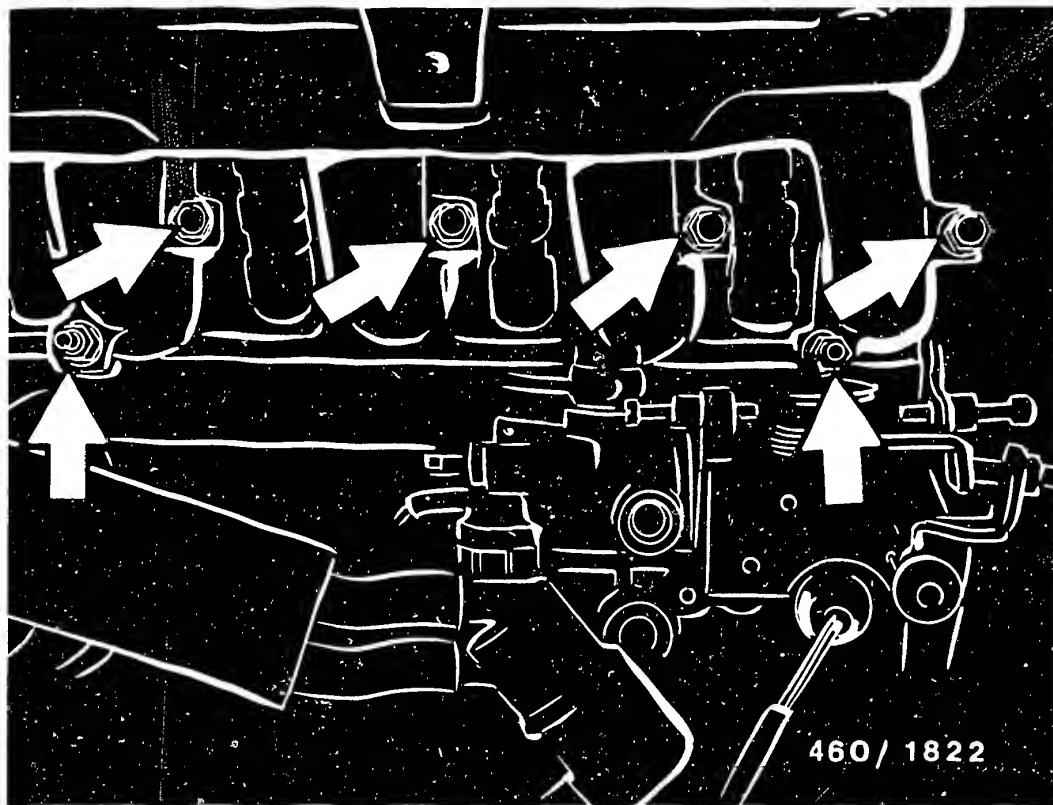
Remove measuring tool KDEP 1085 with dial indicator.

Screw bleeder screw (arrow) with new gasket into central screw plug.

Tighten fuel-injection tubing using open-ring wrench KDEP 1115, while preventing the delivery-valve holders from turning (out of adjustment) by counterholding.

Mount oil filter.





Bolt on air filter housing with intake manifold and new gasket to 25 Nm (arrows).

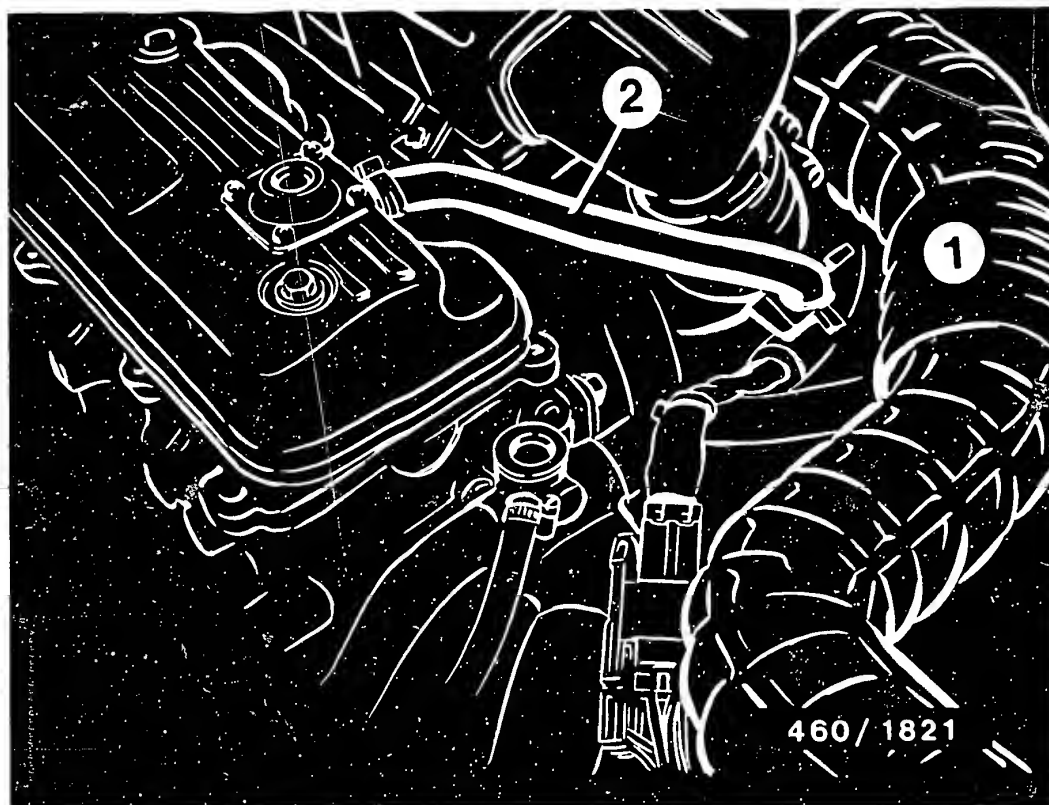
Mount upper toothed-belt cover.

Mount water hoses to upper toothed-belt cover.

Connect crankcase breather, and vacuum hose to air filter housing.

Assemble air-intake hose.

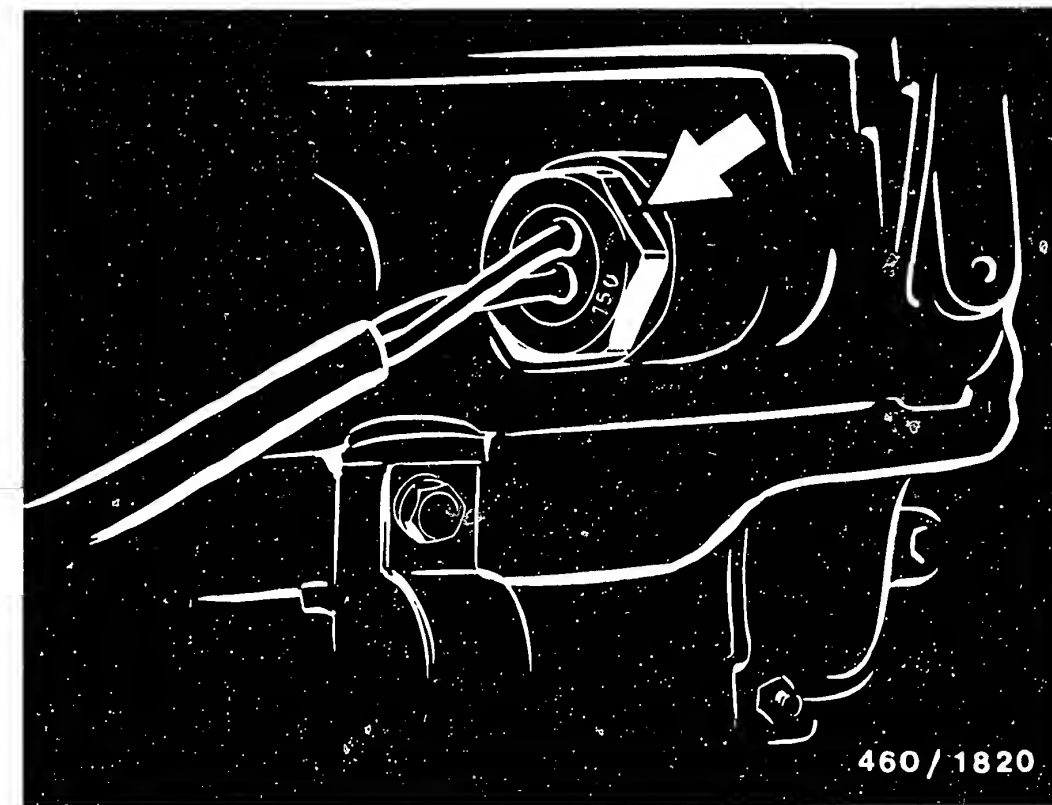
Connect negative terminal to battery.



1 = Air-intake hose, air filter  
2 = Hose, crankcase breather

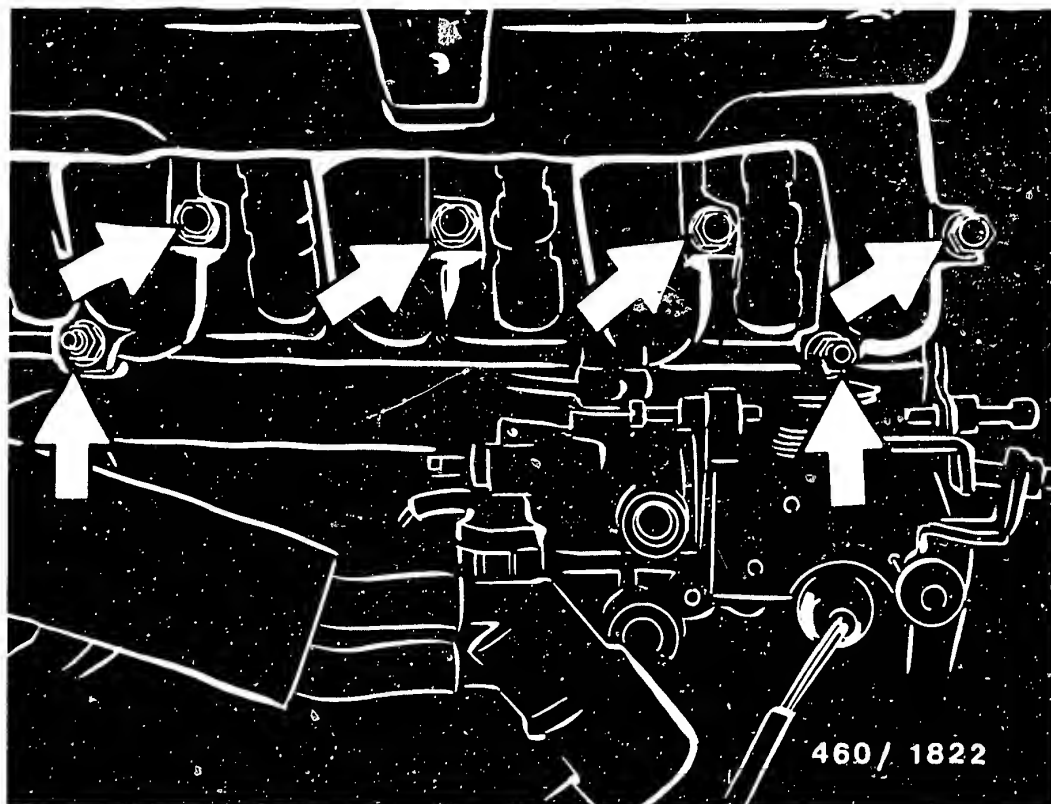
#### COORDINATION, INJECTION PUMP - ENGINE (INJECTION TIMING)

Disconnect negative cable from the battery.  
Remove air-intake hose from air filter.  
Remove crankcase breather and unscrew vacuum hose from air filter.



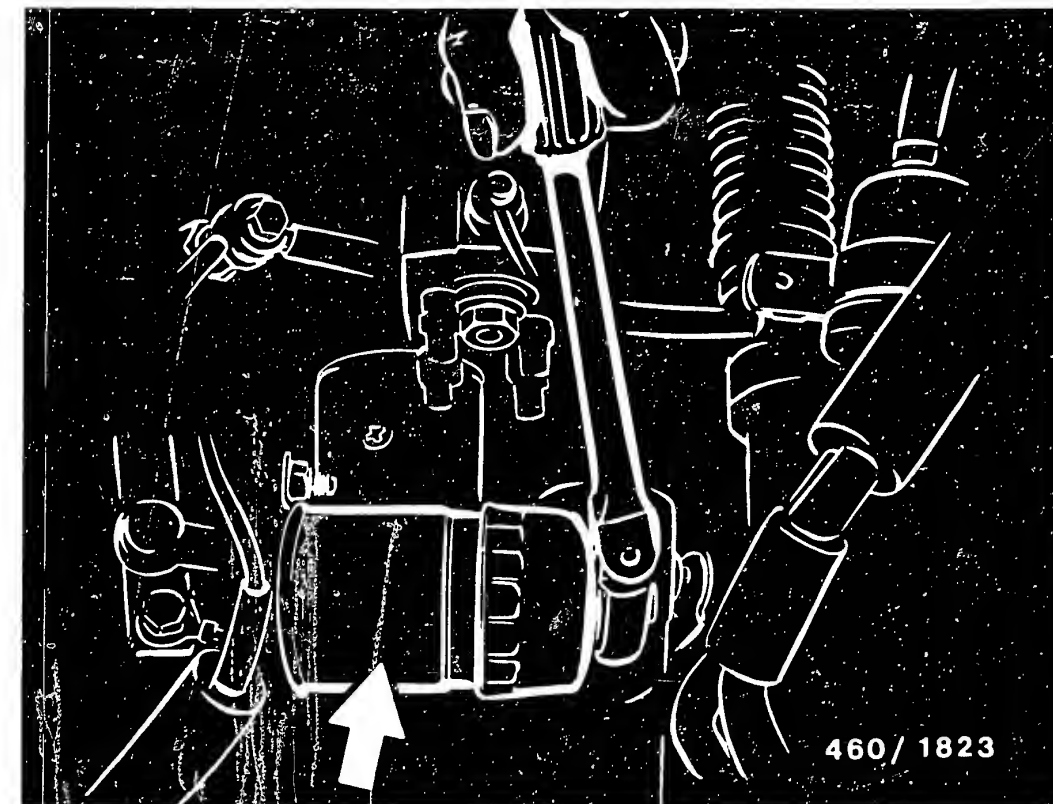
Arrow = Series resistor

Disconnect lead to series resistor.  
Unscrew fuel filter.



Remove fastening bolts of intake manifold (arrows).

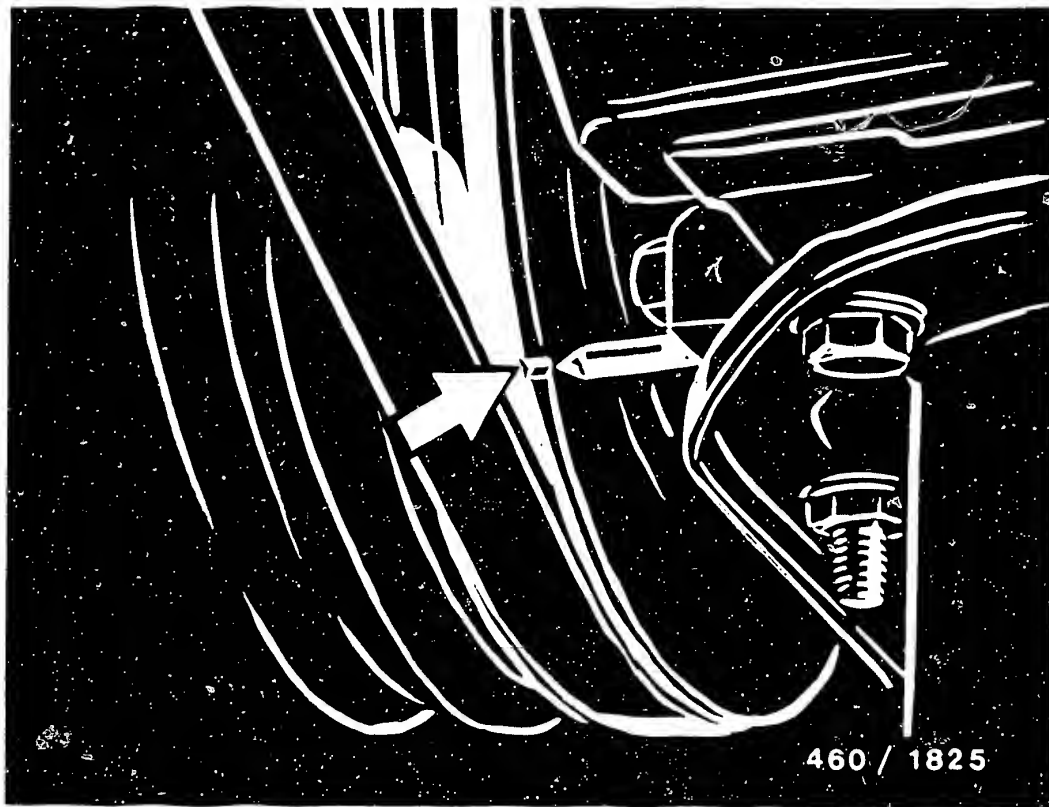
Remove intake manifold with air-filter housing.



Arrow = Oil filter

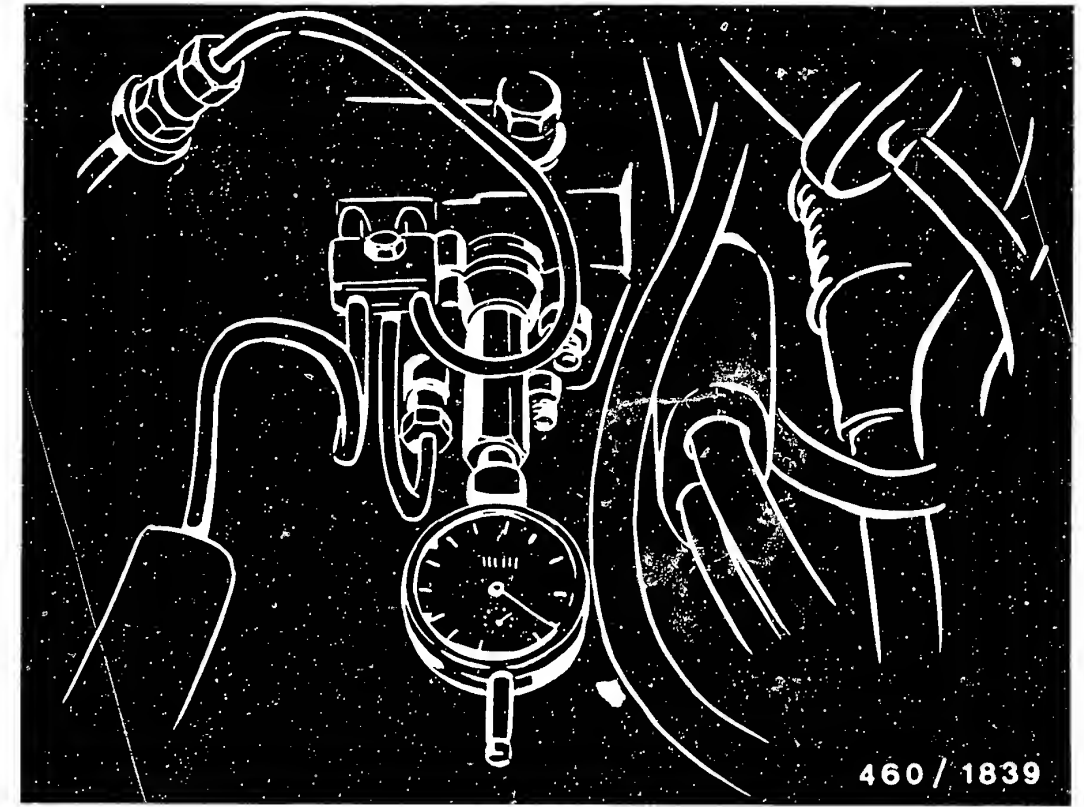
Unscrew oil filter using commercially available tool.

Unscrew vacuum-line bracket and connecting lead of alternator.



Turn crankshaft in the direction of engine rotation until the marking of the crankshaft pulley aligns with the pointer on the engine block.

The piston of cylinder 1 is at TDC, the valves of cylinder 4 are on overlap.

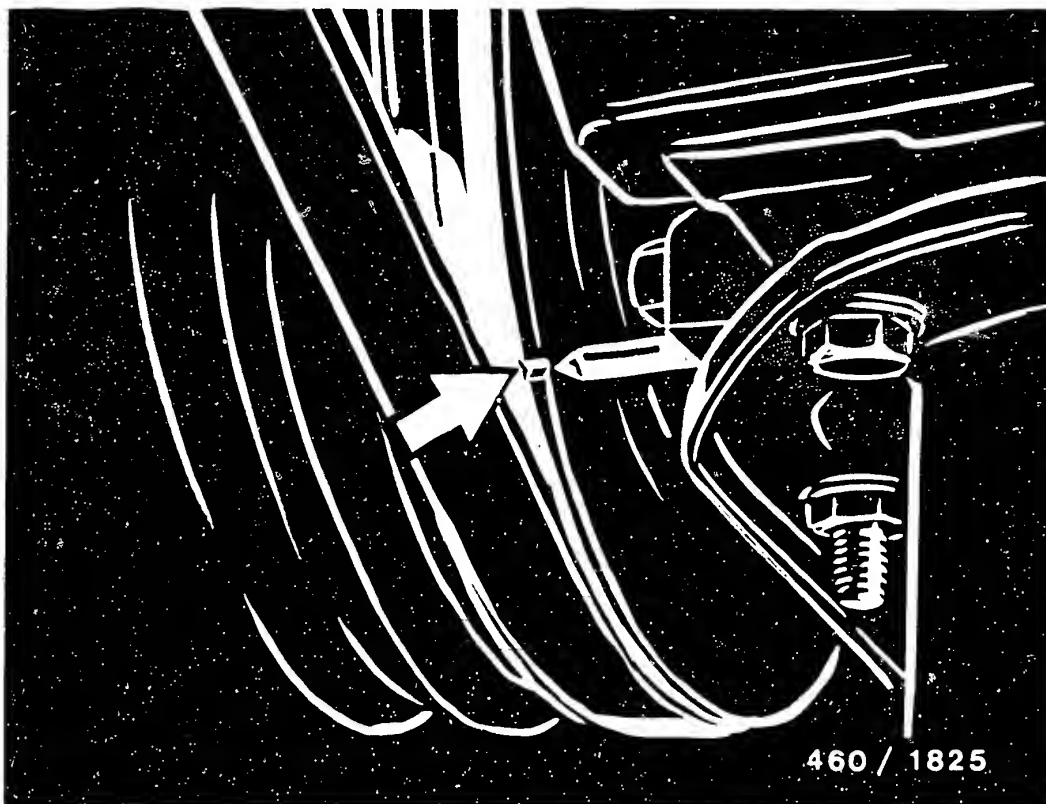


Remove fuel-injection tubing.

Screw bleeder screw out of central screw plug (triangle-head bolt) of the hydraulic head.

Mount measuring tool KDEP 1085 into the tapped hole of the bleeder screw.

Insert dial indicator with measuring insert into measuring tool KDEP 1085.



Preload dial indicator by approx. 5.0 mm.  
Turn crankshaft slowly against the direction of engine rotation until the pointer of the dial indicator no longer moves.  
Preload dial indicator by approx. 1.0 mm and set to "0".

Turn crankshaft in the direction of engine rotation until the TDC marking on the crankshaft pulley aligns with the pointer on the engine block.

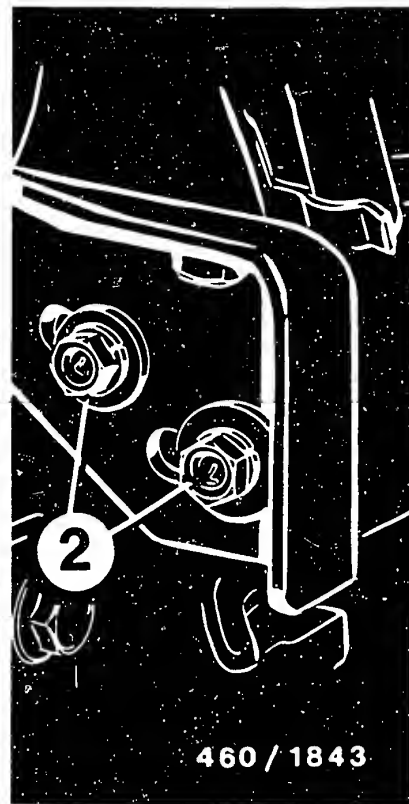
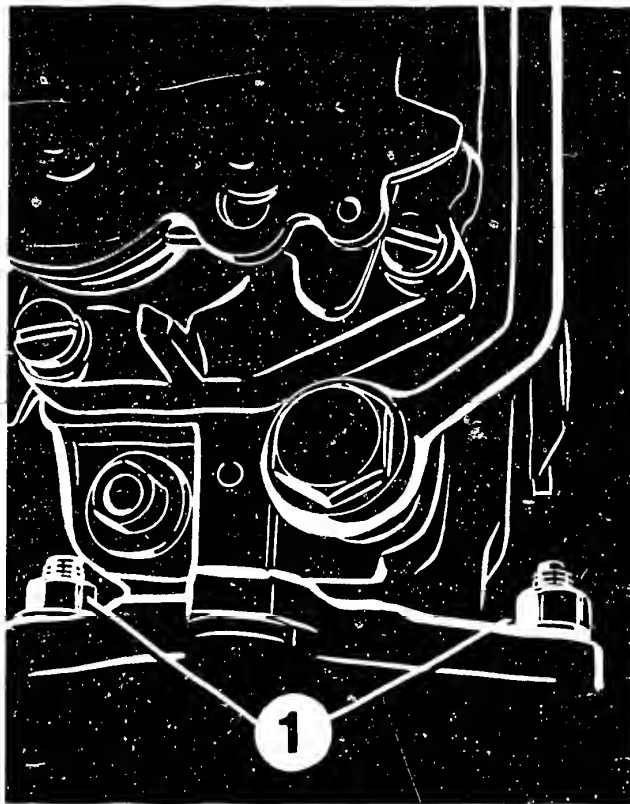
In this position, the dial indicator must indicate a stroke (for dimension, see brief instructions) after BDC.



If necessary, correct stroke by pivoting the injection pump.

Value too high: pivot pump toward engine.  
Value too low: pivot pump away from engine.

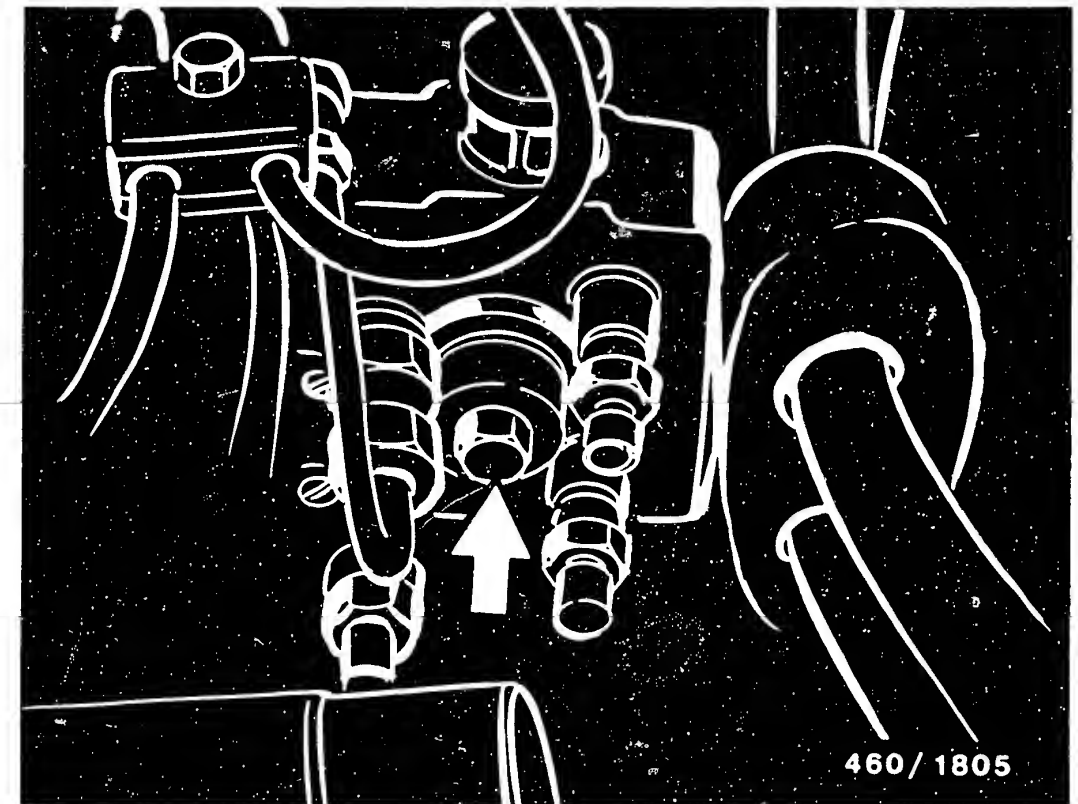
Turn over crankshaft twice and check adjustment.



460 / 1843

Tighten fastening nuts of injection pump (1) to 25 Nm.

Tighten fastening screws of support bracket (2) to 45 Nm.



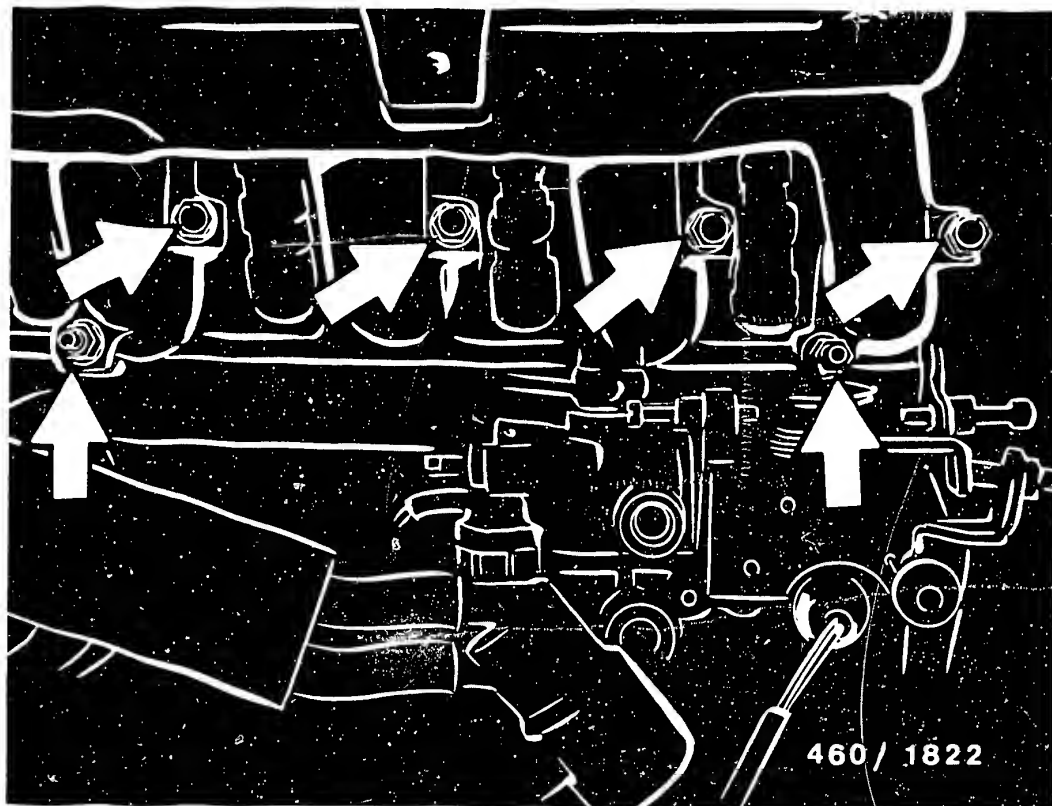
460 / 1805

Remove measuring tool KDEP 1085 with dial indicator.

Screw bleeder screw (arrow) with new gasket into central screw plug.

Tighten fuel-injection tubing using open-ring wrench KDEP 1115, while preventing the delivery-valve holders from turning (out of adjustment) by counterholding.

Mount oil filter.



Bolt on air filter housing with intake manifold and new gasket to 25 Nm (arrows).

Connect crankcase breather and vacuum hose to air-filter housing.

Connect series resistor.

Assemble air-intake hose.

Connect negative terminal to battery.

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